

# ***Increasing Community Confidence in ROMS-BEC***

## **Vision and Collaborative Workplan**

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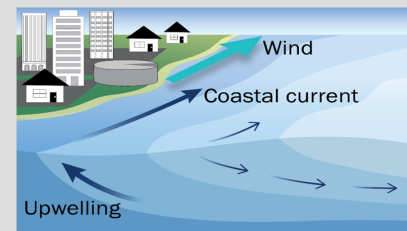
**May 19, 2026**

# BACKGROUND

- **2014: An Expert Panel recommended that California invest in an ocean numerical model to quantify human nutrient influences on OA and hypoxia**
  - Increase resilience to climate change
  - SCCWRP formed a partnership with UCLA in 2013 to develop a coupled physical-biogeochemical model
- **Spent a decade developing, validating, and applying the model**
  - 5 universities, 20+ scientists
  - Published ~ 100+ journal manuscripts on the model, biological interpretation tools, and their basic science and management applications

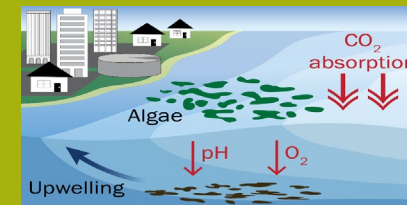
## ROMS Regional Ocean Modeling System

A physical circulation model that predicts how ocean water circulates



## BEC Biogeochemical Elemental Cycling Model

Predicts how human & ocean nutrient fuel plankton blooms that consume oxygen and lower pH



Ambient CO<sub>2</sub>



# WE TRANSITIONED FROM MODEL DEVELOPMENT TO RUNNING SIMULATIONS ON LAND-BASED NUTRIENTS IN THE BIGHT

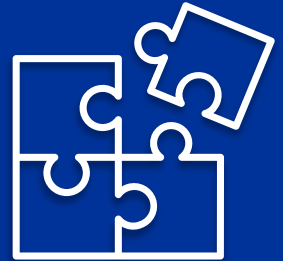
- **Focused on regional “bookend” scenarios with and without nutrients**
  - The bookend runs predict nutrient inputs have a non-trivial effect on acidification hypoxia, and risk of toxic harmful algal blooms
- **Ran scenarios of “one-size-fits-all” nutrient management and effects of outfall discharge volume**
  - Concluded that nutrient management reverses OAH habitat compression, but no attempt at trades of cost-versus effects
- **Some community members expressed concern about whether the model is mature enough for use as a decision support tool**
  - To influence billions of dollars in infrastructure upgrades

# EXPERT PANEL REVIEWED THE MODEL

- **Steering Committee of executive managers from the regulated community and regulatory agencies was formed to guide the Panel process**
  - Administered through National Water Research Institute to ensure independence
- **Six internationally renowned experts met for over a year**
  - Report was released in February 2025
- **They concluded that the model is built on fundamental principles of physical and biogeochemical oceanography**
  - They provided us a roadmap of 40 recommendations to enhance its managerial usefulness

# SCCWRP IS COMMITTED TO FIND THE RESOURCES TO ADDRESS HIGH PRIORITY PANEL RECOMMENDATIONS

- **Steering Committee helped to prioritize them**
  - Discriminate "nice to have" from critical activities among 40 recommendations
- **City of San Diego, Orange County San, LA County San, and LA San, CASA and HDR are partnering with SCCWRP to tackle those priorities**
  - Actively working on first phase of activities to begin to address Panel recommendations
- **We are leveraging that effort with ongoing research with multiple partnerships**



CASA Study  
Phase I: 18 Months  
Next Phase: 36  
months

Leveraged Studies  
[Ongoing research  
with partners OPC-  
NOAA-State Board]

# FOUR CLASSES OF EXPERT PANEL RECOMMENDATIONS

1. Enhance model and biological interpretation tools
2. Quantify model uncertainty
3. Transition to a community model
4. Next round of model runs

# 1. ENHANCE MODEL & BIOLOGICAL INTERPRETATION TOOLS

## Panel Gave Three Recommendations:

- **Update model simulations through present day**
  - Currently the ROMS-BEC hindcasts cover 1997-2017
  - Nutrient management has occurred since then
- **Expand the biological endpoints used to interpret chemical model outputs**
  - Expand beyond the sentinel species used to predict OAH habitat compression
- **Additional validation for very nearshore and plume scale modeling applications**
  - Particularly important for outfall plume fate and effects with progressive volume reductions

# CASA STUDY: UPDATING THE MODEL THROUGH PRESENT DAY

*Most important piece of this task is “getting the nutrient loading right”!*

- **HDR and SCCWRP are teaming to compile and update land-based sources of nutrients to the model**
  - HDR is compiling ocean and inland POTW NPDES and facility data
  - SCCWRP is compiling riverine and Mexican transboundary flow data
- **We still have some significant data gaps for outfall constituent data**
  - For example, as of 2017, 61% of utilities report nitrate, 35% of utilities reporting silicate, 35% of utilities report parameters need to calculate acidification impacts
- **Where we don't have constituent data to represent outfall discharges, we make assumptions based on engineering rules of thumbs**
  - HDR is coordinating a voluntary program to help utilities improve representation of their outfall in the model

# LEVERAGE: EXPANDING MODEL TO INCLUDE OTHER BIOLOGICAL EFFECTS

- **We have observational evidence that nutrients are linked to domoic acid harmful algal blooms (HABs)**
  - But observations alone don't tell us how human nutrients are amplifying the risk above natural (upwelling) sources
- **Since 2016, we have been developing and validating a domoic acid submodel of ROMS-BEC**
  - ROMS-BEC-DA application to the Bight published last year
- **Seeking partnerships to work together to improve and apply ROMS-BEC-DA**
  - Improve ambient observations of toxic HABs for model validation and improve baseline, before planned upgrades take place
  - Get the loads right—silicate really matters for toxicity of blooms, so we need to get a better handle on what's controlling mass balance in the Bight

# LEVERAGE: ENHANCE MODEL FOR NEARSHORE AND PLUME FATE AND TRANSPORT

- **Can we represent the dispersion of reduced outfall volumes and changing constituents appropriately?**
  - 300 m resolution model grid designed to answer regional scale question
- **Working to increase resolution, without increasing computation cost**
  - Moving from uniform 300 grid to flexible grid with 40 meters around the outfall
- **Discussing with OCSan how to leverage their ROMS-BEC GWRS study**
  - Detailed model validation over period their groundwater replenishment system was progressively implement

## 2. QUANTIFY UNCERTAINTY

### Panel Recommended:

- **Documenting sensitivity of model endpoints to parameterization**
  - Previous work was not published
- **Improve model validation**
  - Add metrics (light, apparent oxygen utilization, vertical carbon flux)
  - New data sets (moored time series)
  - Extend validation to current day (heat waves, nutrient management)
- **Develop an approach to put an error bar on modeled estimates of change**

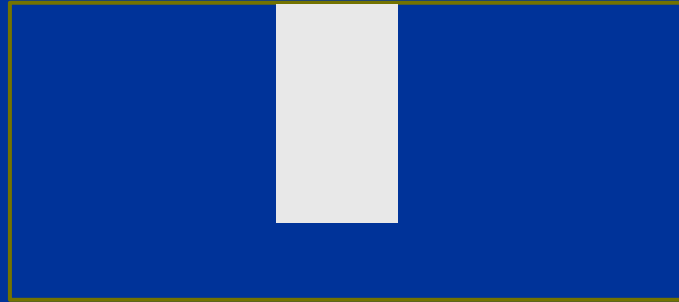
# CASA STUDY: SENSITIVITY ANALYSIS AND VALIDATION

- **Documenting sensitivity of model endpoints to parameterization**
- **Update model validation methodologies, with Panel recommended approaches**
  - Compile and assess observational data availability, quality , improve documentation
  - Get consensus on validation metrics and statistics with CTAG Model Subcommittee
- **Apply and evaluate model simulations of 1997 through 2017, identify any corrective actions needed**

*.....Next Phase: Extend validation studies with model hindcasts through 2024, using improved approach*

# LEVERAGED STUDIES: QAPP, UNCERTAINTY QUANTIFICATION

- **SCCWRP collaborated with CTAG Subcommittee to develop a QAPP**
  - Water Board is working towards adoption
- **Developing approaches to “add error bars” to model findings**
  - Worked with Subcommittee to identify readiness and resource needs to implement those approaches



- **Quantifying uncertainty in biological responses**
  - Are patterns in predicted biological impacts consistent with the model outputs?
  - Bight RMP working to quantify OA biological impacts (shell dissolution)

### 3. TRANSITION TO A COMMUNITY MODEL

*Managerial value increases when people making decisions can employ the model themselves*

#### Panel recommended:

- **Improve model documentation**
  - Make it easier for others outside ROMS research community to use it
- **Make the model output easy for others to access and reanalyze**
  - Provide “engineering level” access to model validation comparisons
  - Allow users to focus down on specific geographies

## **CASA STUDY: IMPROVING MODEL DOCUMENTATION, DATA VISUALIZATION**

- **Model documentation**
  - Cataloging system to link output datasets with the model's source code
  - Data dictionary
- **Getting consensus on how the community wants to view outputs**
  - Subregional to outfall scale nutrient budgets
  - Habitat compression at customizable scales

## **LEVERAGE: ACCESS TO OUTPUTS, USER INTERFACE, TRAINING**

- **IOOS partnerships providing access to model outputs**
  - CenCOOS is featuring ROMS-BEC outputs available for download on their portal
  - SCCOOS-funded project to build and beta-test interfaces for interactive viewing of validation graphics and statistics
- **Train partners**
  - Training HDR to run ROMS-BEC

## 4. NEW MODEL RUNS

*A key use of ROMS-BEC is to simulate the effect of management actions, before you spend money on those actions*

- **Management Scenario Committee → identifying what scenarios to run**

- Transparency: We want all parties to know what scenarios we are running
- Collaboration: Can we design scenarios that everyone agrees are meaningful?
- Leveraging: Shared funding when there is mutual interest in scenarios

- **The Committee is a discussion body, not an approval body**

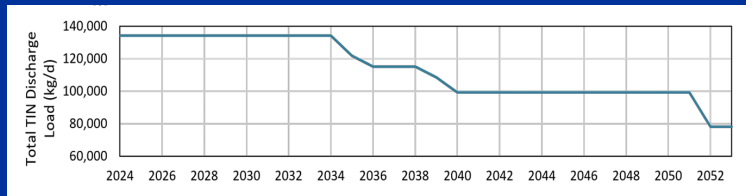
- **Membership**

- Lan Wiborg, OC San (Large POTWs)
- Steve Wagner, Goleta SD (Small POTWs)
- Karen Mogus, State Water Board
- David Gibson, San Diego Board (Regional Boards)
- Justine Kimball, OPC
- Serge Dedina, Wild Coast (Env. NGO)
- Sean Bothwell, Coastkeeper (Env. NGO)
- Steve Weisberg, SCCWRP (ex officio)
- Ami Latker, CSD (Chair of CTAG Model Subcommittee)

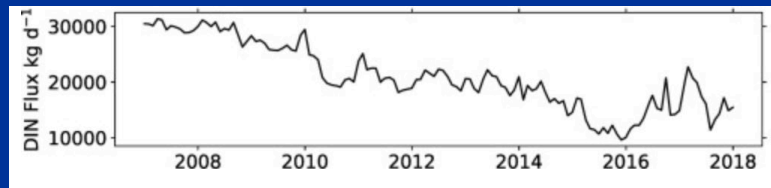
# WHAT KINDS OF MODEL RUNS ARE BEING DISCUSSED?

- **Future nutrient management scenarios, e.g.**
  - Priority: Planned infrastructure upgrades
- **What about the effect of load reduction that has already occurred?**
  - OC San: has already implemented a 40% load reduction, over an 18-year period
  - Run model to identify at what point progressive load reduction is distinguishable from model uncertainty
- **Scenarios that provide additional context**
  - Climate change, mid and end-of century
  - Alternative solutions: bivalve and kelp farming, kelp restoration

HDR Report: Planned Upgrades in the SCB



Change in OCSan Nitrogen Discharge (2005-2018)



# HOW CAN WE ENSURE QUALITY OF THE WORK?

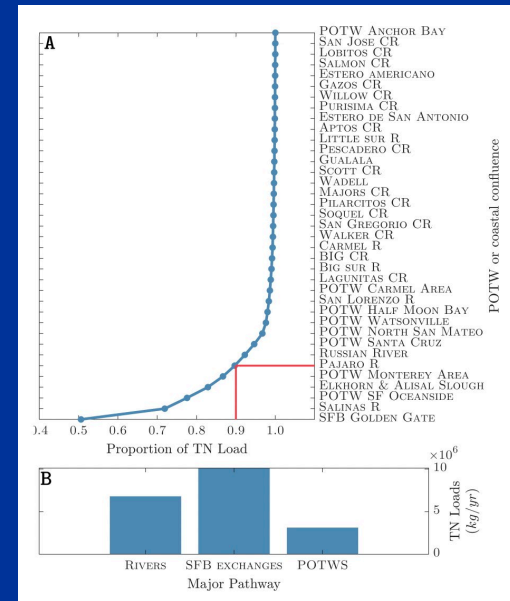
## *Three mechanisms*

- **Continue to emphasize journal peer review**
- **CTAG Modeling Subcommittee**
  - Scientific staff from agencies
  - Community science advisors (HDR, SCCOOS, NOAA Fisheries Science Center)
- **Follow-up review by the Independent Expert Review Panel**

# THIS TALK FOCUSED ON THE SOUTHERN CALIFORNIA BIGHT

## BUT WE HAVE A PARALLEL MODELING EFFORT ONGOING IN THE SAN FRANCISCO AND MONTEREY COAST

- **Model set up, preliminary model validation**
- **Pathway attribution**
  - San Francisco Bay nitrogen export roughly equal to Salinas River
  - Coastal POTWs are locally important, but order of magnitude less than SFB and Salinas River
- **Need for refinements in nutrient loads**
  - Improved representation of ag-dominated rivers
  - Updates to represent recent nutrient management upgrades
  - Linkage with SFEI NMS Bay model



**QUESTIONS?**

**THANKS! [MARTHAS@SCCWRP.ORG](mailto:MARTHAS@SCCWRP.ORG)**

**THANK YOU!**

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# CASA-Member Funded Phase I Tasks

- **Project administration and documentation**
  - Model log and versioning list, data dictionary
  - Tracking of modeling studies
- **Update model simulations to 2024**
  - Update land-based inputs
  - Update ocean forcing
- **Model skill assessment, utilizing existing simulations through 2017**
  - Agree on metrics and statistics of skill assessment
  - Conduct assessment, focusing on priority parameters
  - Reporting, with recommendations for more focused, Phase II analyses and/or data collection
- **Sensitivity analyses**
  - Literature review and analyses of existing 5 km sensitivity analyses
  - Reporting, with recommendations for focused, Phase II analyses
- **Data visualization for applications**
  - Geographic context for model results (habitat compression, nutrient budgets)