CALIFORNIA OCEAN PROTECTION COUNCIL

Item 4a

Staff Recommendation
October 17, 2016

Advance integrated modelling of California's coastal ocean to inform ocean acidification and hypoxia policy

Jenn Phillips, Program Manager

RECOMMENDED ACTION: Authorization to disburse up to $1,100,000 to the Regents of the University of California, Los Angeles (UCLA) to advance and enhance integrated modeling of the California Current System in order to understand the effects of ocean acidification and hypoxia on food webs and the nearshore environment, and quantify the extent to which local sources are exacerbating ocean acidification and hypoxia.

LOCATION: Statewide

STRATEGIC PLAN OBJECTIVE(S): Climate Change, Science-Based Decision Making, Coastal and Ocean Impacts from Land-based Sources

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EXHIBITS

Exhibit A: Support Letters

FINDINGS AND RESOLUTION:

Staff recommends that the Ocean Protection Council (OPC) adopt the following findings:
"Based on the accompanying staff report and attached exhibit(s), the Ocean Protection Council hereby finds that:

1) The proposed projects are consistent with the purposes of Division 26.5 of the Public Resources Code, the Ocean Protection Act.
2) The proposed projects are consistent with the Ocean Protection Council's grant program funding guidelines (Interim Standards and Protocols, August 2013).
3) The proposed project is not a 'legal project' that triggers the California Environmental Quality Act (CEQA) pursuant to Public Resources Code section 21068 and Title 14 of the California Code of Regulations, section 15378."

Staff further recommends that the OPC adopt the following resolution pursuant to Sections 35500 *et seq.* of the Public Resources Code:

"The California Ocean Protection Council hereby approves the disbursement of up to $1,100,000 to the Regents of the University of California, Los Angeles (UCLA) to advance and enhance integrated modeling of the California Current System in order to understand the effects of ocean acidification and hypoxia on food webs and the nearshore environment, and quantify the extent to which local sources are exacerbating ocean acidification and hypoxia.

This authorization is subject to the condition that prior to disbursement of funds, the Regents of the University of California, Los Angeles shall submit for the review and approval of the Executive Director of the OPC detailed work plans, schedules, staff requirements, budgets, and the names of any contractors intended to be used to complete the projects, as well as discrete deliverables that can be produced in intervals to ensure the projects are on target for successful completion. All projects will be developed under a shared understanding of process, management and delivery."

PROJECT SUMMARY:

The overarching goal of this project is to advance and enhance integrated modeling of the California Current System in order to understand the effects of ocean acidification and hypoxia on food webs and the nearshore environment, and quantify the extent to which local sources are exacerbating ocean acidification and hypoxia.

In 2013, the OPC asked California Ocean Science Trust to convene the West Coast Ocean Acidification and Hypoxia Science Panel (Panel; http://westcoastoah.org) to summarize the state of the knowledge, but more importantly to present management actions to address ocean acidification and hypoxia. The Panel developed a suite of recommendations to help water quality and marine resource managers of the California Current Large Marine Ecosystem (CCLME) respond to the emerging threats of ocean acidification and hypoxia (OAH). As part of their body of the work, the Panel explored how local pollution inputs may exacerbate OAH across the West Coast. Among their recommendations is to accelerate the development of coupled physical, biogeochemical, and ecosystem models to help managers better understand the implication of OAH for marine resource management and to determine whether reduction in local pollution inputs can mitigate OAH stress to marine resources.

OPC staff recommends adding additional research and outreach recommendations to augment the present OAH modeling project which is funded by both OPC[1] and NOAA. Currently this West Coast model is funded to build, parameterize and then translate a coast wide (stretching from Baja to Canada) model. Additional funding would help look at the effect of OAH on food webs (and not just a single species), would model the nearshore environments at a finer grid scale to better be able to tease apart and quantify the role of discharge and river eutrophication on

[1] http://www.opc.ca.gov/webmaster/ftp/pdf/agenda_items/20130628/Item6_20130628_staff_rec_OA.pdf

OAH. In addition to these physical changes to the model, once it is calibrated and up and running, model analyses will be done to consider how different management decisions and strategies will help us mitigate and adapt to OAH. The group also proposes to hold regular modelling forums with managers and decision-makers. Building on that, the model will be used to help the San Francisco Bay Regional Water Quality Control Board (SFBRWQCB) with their nutrient management strategy and help these managers understand how much nutrients need to be limited.

This enhanced and expanded upon modelling project will produce the following deliverables and projects:

Additional modeling efforts:

1. Modeling the Effects of Climate Change on Food Webs

Understanding the ecological effects of climate change is critical for resource management. Although most studies of the ecological effects of climate change have thus far focused on individual species, there is an increasing understanding of the importance of indirect effects of climate change, including effects on food webs. This additional modeling effort will examine the effects of OAH on food webs in two marine realms: the California Current, and very nearshore habitats (such as rocky intertidal habitats).

a. The California Current

The California Current hosts one of the most productive ecosystems of the global ocean, and sustains diverse and rich animal assemblages, from abundant zooplankton (e.g. krill) to forage fish (sardines, anchovies) and their predators, including many charismatic species of economic and conservational interest. Despite the diversity and ecological complexity, these communities show remarkably coherent responses to large-scale biogeochemical drivers over interannual and decadal timescales, which challenge current paradigms of bottom-up controls. Understanding the nature of these responses is daunting, but offers an opportunity for a deeper understanding of ecosystem behavior, its coupling to the environment, and its response to warming, acidification and hypoxia - all of which have implications for resource management.

With additional funding, this project will extend the current modeling system to include higher trophic levels communities (in addition to the lower trophic levels that are embedded within the current model) that are fully coupled to the biogeochemistry of the California Current region. The current state-of-art hydrodynamic and biogeochemical solutions developed by Dr. McWilliams' group at UCLA offer the perfect starting point to undertake this effort.

b. Very nearshore coastal habitats

Very nearshore coastal habitats, such as rocky intertidal habitats, represent unique ecosystems with high ecological and human use values. Despite their importance, relatively little research has been done to assess the likely effects of OAH in these coastal habitats. Recently, some research focusing on effects of ocean acidification on rocky intertidal organisms has been reported, but these generally focus on individual species rather than indirect effects. Studies of system-wide ecological impacts of ocean acidification on very nearshore coastal habitats have not been done.

The current modeling project addressing the effects of ocean acidification and hypoxia on the ecosystem along the U.S. West Coast includes some regional foci. However, to properly examine the nearshore expressions of hypoxia and acidification, in particular due to river eutrophication and wastewater discharge, finer resolution is required. This project will model a few selected regions a finer resolution (potentially Santa Monica, San Pedro and Monterey Bays and the mouth of San Francisco Bay) to provide information needed to link to very nearshore coastal habitats. Because along California's coast, oxygen and pH decrease with depth, the crucial issue for nearshore harmful effects is how much offshore, subsurface water is carried up and over the shelf by currents and waves. This work builds both on the present larger-scale modeling project and on published analyses of nearshore currents and transport.

Ultimately, the physical model results will be linked quantitatively to very nearshore ecosystems using an ecosystem model. In addition, researchers will conduct a literature review on impacts of OAH on very nearshore coastal habitats. This information will be used to develop conceptual models of OAH impacts on very nearshore coastal ecosystems. By providing information about likely future effects of OAH on very nearshore coastal ecosystems, this effort will provide resource managers with essential information for managing these systems in ways that protect critical species and ecosystem function.

2. Modeling Scenario Analyses to Support Management Discussions

Use of the coupled physical-biogeochemical model to support management discussions requires that the management community become actively involved in helping to specify model simulations across varying scales. Current resources are focused on model development and validation, with limited resources available for scenario analyses applicable to management. Once the model has been developed, calibrated and run on the proposed management scenarios, Southern California Coastal Water Research Project (SCCWRP) and UCLA will develop additional management scenarios designed to reduce coastal OAH impacts, in consultation with coastal resource, water quality, and water infrastructure managers, for further model runs. A

larger number of model runs based on a wider array of possible management scenarios should prove valuable for coastal managers to develop OAH mitigation and adaptation strategies.

Outreach and Engagement:

1. Modeling Forums

The West Coast Ocean Acidification and Hypoxia Science Panel (Panel) called for modeling forums that bring scientists and managers together to synthesize local and regional management needs, and to ensure that scientists are working in a coordinated, synergistic fashion to address those management needs. This organized community of modelers, observational researchers, and managers can serve to: (1) provide a vehicle for dialogue on management goals and scenarios, (2) encourage discussion on the use of model outputs to illustrate outcomes of management options to reach those goals, (3) facilitate discussion about the level of validation needed to use models to support management decisions, and (4) coordinate modeling products among different technical specialists. The first critical action that the Panel identified is to convene a series of workshops to summarize regional and local management needs and identify the status of existing models to support those needs. This OPC funding will get this process started (with two workshops to summarize key regional and local management needs) while Federal and other funding sources can be identified to maintain forums into the future.

2. Use of coupled physical biogeochemical model to support interaction with stakeholders in San Francisco Bay

The San Francisco Regional Water Quality Control Board (SFRWQCB) is developing nutrient objectives for San Francisco Bay (SFB) and has established a nutrient management strategy that involves development of a coupled physical biogeochemical model to support discussions on management of nutrient loads by 37 Publically-Owned Treatment Plants (POTW) that discharge directly to SFB (www.waterboards.ca.gov/sanfranciscobay/water_issues/programs/planningtmdls/amendments/estuarynne.shtml). Collectively, these POTWs are contributing $1 million per year to develop a science program to develop and validate this model to support nutrient management discussions. This modelling team funded by OPC and NOAA will be downscaling model output, but no resources are currently available to coordinate with the SFB Science Team, led by the San Francisco Estuary Institute, to use the models synergistically. This funding would provide resources to more readily link the complementary scientific efforts and to interact with stakeholders to utilize model output to inform management actions. SCCWRP has had a lead role on the SFEI-led SFB Science Team and will provide the leadership for this stakeholder interaction. Funding will provide resources for a level of interaction similar to what is currently

being conducted with stakeholders in Southern California, the other "epicenter" of anthropogenic nutrient inputs. For San Francisco Bay, this includes an assessment of the effects of Bay outwelled nutrients on OAH near the Gulf of Farallones National Marine Sanctuary and an evaluation of the net effect of nutrient management scenarios for OAH during current condition and future scenarios of land use and climate change.

The proposed work will also directly address the actions that are described in AB 2139 (Williams), specifically to develop, refine, and integrate predictive models that identify the relative contributions of global and local drivers of ocean acidification and hypoxia in California waters.

Project Timeline: 3 years

PROJECT FINANCING:

Staff recommends that the Ocean Protection Council (OPC) authorize disbursement of up to $1,100,000 to the Regents of the University of California, Los Angeles (UCLA) to advance and enhance integrated modeling of the California Current System in order to understand the effects of ocean acidification and hypoxia on food webs and the nearshore environment, and quantify the extent to which local sources are exacerbating ocean acidification and hypoxia.

Ocean Protection Council	$1,100,000
TOTAL	**$1,100,000**

The anticipated source of funds will be from the Ocean Protection Council's appropriation of the Safe Drinking Water, Water Quality and Supply, Flood Control, River and Coastal Protection Bond Act of 2006 (Proposition 84). Proposition 84 authorizes the use of funds for purposes consistent with Section 35650 of the Public Resources Code, establishing the California Ocean Protection Trust Fund (Pub. Res. Code § 75060(g)). Under Section 35650(b), Ocean Protection Trust Fund monies may be expended for projects authorized by the OPC that are identified as appropriate Trust Fund purposes, as specified. The project is consistent with the Trust Fund purposes as discussed in the following section.

Leverage of OPC funds

This project builds on an existing grant OPC has with University of California, Los Angeles which was approved by the Council in June 2013. This project – "Integrated modeling of California's coastal ocean to inform ocean acidification and hypoxia related policy" – received additional support from NOAA after OPC approval.

CONSISTENCY WITH CALIFORNIA OCEAN PROTECTION ACT:

The proposed project is consistent with the Ocean Protection Act, Division 26.5 of the Public Resources Code, because it is consistent with trust-fund allowable projects, defined in Public Resources Code Section 35650(b) as projects which:

- Improve management, conservation, and protection of coastal waters and ocean ecosystems
- Provide monitoring and scientific data to improve state efforts to protect and conserve ocean resources
- Provide funding for adaptive management, planning, coordination, monitoring, research, and other necessary activities to minimize the adverse impacts of climate change on California's ocean ecosystem, including, but not limited to, the effects of sea level rise, changes in ocean productivity, and ocean acidification on coastal and ocean habitat, wildlife, fisheries, chemistry, and other key attributes of ocean ecosystems and to increase the state's understanding of the ocean's role in carbon sequestration. Adaptive management strategies, planning, research, monitoring, or other activities shall be designed to improve the management of coastal and ocean resources or aid the state to adapt to climate change impacts.

This proposed project will provide the scientific foundation for water quality managers and state agencies to protect and conserve ocean resources. By understanding the extent to which land-based nutrient loading and runoff contributes to ocean acidification at a local and regional scale, we will be able to make important policy and management decisions surrounding local acidification reduction strategies that are backed by robust science. The additional funding requested would allow the researchers and other partners to initiate modelling forums between the science and modelling community and the management and regulatory community, and already with existing funds the team has established a stakeholder advisory committee.

CONSISTENCY WITH THE OPC'S STRATEGIC PLAN:

This project will implement Focal Area A: Science-based decision-making, Focal Area B: Climate Change, and Focal Area D: Coastal and Ocean Impacts from Land-based Sources. This project will leverage the scientific community to support management and policy direction. It will also improve our understanding of how climate change and ocean acidification will alter California’s ocean and coastal ecosystems, and deepen our understanding of how nutrient runoff from the land may add to local ocean acidification in different areas along the California coast. By understanding this and quantifying how much nutrient loading might add to or exacerbate ocean acidification, we will be able to identify opportunities to improve policies to reduce land-based impacts to the ocean.

CONSISTENCY WITH PROPOSITION 84 (The Safe Drinking Water, Water Quality and Supply, Flood Control, River and Coastal Protection Bond Act of 2006; Public Resources Code §75060(g)

This project is consistent with the purposes outlined in Proposition 84, specifically it includes the development of scientific data needed to adaptively manage the state's marine resources and reserves. Model output and data to both understand the effects of climate change (ocean acidification) on food webs and the potentially compounding stressors of ocean acidification and nutrient loading in the nearshore environment will help us adaptively manage and plan for the future.

CONSISTENCY WITH THE OPC'S GRANT PROGRAM FUNDING GUIDELINES:

The proposed project is consistent with the OPC's Grant Program Funding Guidelines for Proposition 84 funds, in the following respects:

Required Criteria

1. Directly relate to the ocean, coast, associated estuaries, or coastal-draining watersheds: *This model is an oceanographic model, but with the continued improvements and enhancements the nearshore environments will be modelled at a finer grid scale to better be able to tease apart and quantify the role of discharge and river eutrophication on ocean acidification and hypoxia.*
2. Support of the public*: See exhibit A*
3. Greater-than-local interest: *This model is a West Coast wide model stretching from Baja to Canada.*

Additional Criteria

4. Resolution of more than one issue: *The proposed project will provide better understanding across the land sea interface of how land-based discharges exacerbate acidification due to atmospheric climate change and hypoxia.*
5. Leverage: *See the "Project Financing" section above.*
6. Coordination: *This model is jointly funded by NOAA and the OPC and involves researchers across the West Coast at Universities, Federal Agencies and a Joint Powers Authority (JPA). It is anticipated that these entities will contribute funds or services, and that these contributions will attract additional partners and contributors.*

COMPLIANCE WITH CEQA:

The proposed project is not a 'legal project' that triggers the California Environmental Quality Act (CEQA) pursuant to Public Resources Code section 21068 and Title 14 of the California Code of Regulations, section 15378.