PROJECT ABSTRACT / SUMMARY

OA 2015: Integrated Modeling of Ocean Acidification and Hypoxia to Support Ecosystem Prediction and Environmental Management in the California Current System

Institutions and Investigators: ***University of California, Los Angeles (UCLA):*** Jim McWilliams (Project Lead PI); Richard Ambrose (co-PI); Daniele Bianchi (co-PI); Mark Gold (co-PI). ***University of Washington (UW):*** Curtis Deutsch (PI); Nina Bednarsek (co-PI); Hartmut Frenzel (co-PI). ***Southern California Coastal Water Research Project (SCCWRP):*** Martha Sutula (PI); Steve Weisberg (co-PI); Karen McLaughlin (co-PI). ***NOAA Pacific Marine Environmental Laboratory (PMEL):*** Richard Feely (PI); Simone Alin (co-PI).

Total Proposed Costs: **$1,499,968** (no ship funds requested) Budget Period: **09/01/2015 – 08/31/2018**

Problem Introduction and Rationale: The California Current System (CCS) is one of the most biologically productive regions of the world ocean, but seasonal upwelling of low oxygen and low-pH waters makes it particularly vulnerable to even small additional reductions in O_2 and/or pH, which have both been observed in recent decades. Three prominent coastal phenomena have been implicated in precisely these changes: 1) large scale acidification and deoxygenation of the ocean associated with climate warming, 2) natural climate variability, and 3) anthropogenic pollution of coastal waters, especially from nutrient discharge and deposition. The relative importance of these drivers has not been systematically evaluated, and yet is critical information in any cost-effective strategy to manage coastal resources at local scales. Disentangling the magnitude and interaction of these different ecosystem stresses requires an integrated systems modeling approach that is carefully validated against available datasets.

Scientific Objectives: The following questions will be addressed: (1). How do the cycles of carbon, oxygen, and nutrients function in the CCS in the presence of large-scale anthropogenic CO_2 inputs and climate changes? (2). How much do local inputs of nutrients and CO_2 contribute to altered primary productivity and OHA? (3). How do rates of OHA from local inputs compare to trends originating from basin-scale climate change and remote transport of anthropogenic CO_2? (4). What are the physiological impacts of OHA on pteropods, and what are valid empirical and model-expressed relationships between pteropod responses and OHA state variables? (5). Which areas of the coast are most susceptible to OHA and how will susceptibility change between now and 2060?

Work to be Completed: (1). Develop an OHA model of CCS (Baja California to British Columbia) based on the Regional Oceanic Modeling System (ROMS), comprising circulation, biogeochemical cycles, and lower-trophic ecosystem of the CCS, with regional downscaling in the So CA Bight, Central CA Coast, and the Oregon Coast. Collect and analyze laboratory and field data on ecologically important pteropod species to derive empirically-based sensitivities of biological rates to OHA and temperature, and incorporate into the model as new ecosystem parameterizations. (2). Use the model to understand relative contributions of natural climate variability, anthropogenically induced climate change, and anthropogenic inputs on the status and trends of OHA in the CCS. Model simulations will be validated against existing field campaign data (e.g., multi-annual CCS-wide surveys conducted by PMEL, the So CA Bight Regional Monitoring Program, the CalCOFI program, and the Newport Hydrographic Line) and (3). Transmit these findings to coastal zone managers and other stakeholders and help them explore the implications for marine resource management and pollution control.