

SCCOOS Certification Application – Gaps

1. Marine Operations

a. Tier 2* - Upgrade and/or replace HF radar hardware as needed

Southern California Coastal Ocean Observing System (SCCOOS) proposes to maintain and improve the network to ensure continued distribution of near real-time surface currents along the coast of Southern California. Along with the physical deployment of HF Radar systems along the coast of California, continued evaluation and calibration of each system is required. Transmit and receive antennas are sensitive to environmental change and surrounding infrastructure, therefore this project will replace aging equipment and infrastructure.

Mapping of ocean surface currents has been identified as a cross-cutting activity to a number of regional observation needs and science issues. Representative stakeholders and users include: commercial cargo (bulk and tanker) and cruise vessels, Catalina Express Ferry, commercial fishermen, harbor pilots (San Diego, Los Angeles, Long Beach and Port Hueneme), the Marine Exchange of Southern California, NWS, NOAA Office of Restoration and Response (OR&R), California Office of Oil Spill Prevention Response (OSPR), the U.S. Coast Guard (USCG), U.S. Navy, USACE dredgers, passenger cruise ships, recreational beachgoers and boaters. The audience includes users of different levels of sophistication and technical knowledge but, all of these stakeholders are interested in both real-time and forecast customized data that complement their decision-support tools.

1. Tier 3* - Gaviota/Refugio Beach: A site at Gaviota, CA would extend SCM coverage to include all of the western Santa Barbara Channel. Radials from this site would be combined with those from Refugio, Coal Oil Point, and possibly Mandalay. Several active oil production platforms are located in the new coverage area of this site. This was the site where SCCOOS installed a temporary system in support of the May, 2015 oil pipeline spill.
2. Tier 3 - Ventura/Carpinteria: This location would offer improved coverage for an area where there are several offshore oil platforms. Radials would combine with established sites at Summerland Sanitary District and Pt. Mugu. Permitting and site location may prove challenging, but this location would fill a noted gap.
3. Tier 3 - Santa Barbara Island: Santa Barbara Island is a small island offshore CA which would improve coverage off LA/LB harbor and then combine with radials from the recommended West Catalina Island location. This site will require solar and/or wind power.
4. Tier 3 - West Catalina Island: Radials from West Catalina Island would combine with radials from Santa Barbara Island and fill in gaps offshore LA/LB harbor. This site may require solar and/or wind power
5. Tier 3 - Santa Cruz Island, south side: Radials from a site on the south side of Santa Cruz Island would combine with radials from sites on the south side of Santa Rosa Island, Pt. Mugu, Ormand Generating station, Zuma Beach, and/ or Leo Carillo State Park to extend coverage to ocean areas south of the Northern Channel Islands. This site will require solar and/or wind power.
6. Tier 3 - Santa Rosa Island, south side: Radials from this site would combine with Santa Cruz Island, south side extending coverage to ocean areas south of the Northern Channel Islands. This site will require solar and/or wind power.

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2. Coastal Hazards

- a. Tier 2/ Tier 3 - Upgrade and/or replace HF radar hardware as needed

3. Climate Variability and Change

- a. Tier 3 - Expand glider operations to cover one alongshore transect

Sampling along an alongshore line just offshore of the Southern California Bight between lines 80 and 90 to collect and distribute glider data in to operational models. Line 90, which is the most observed line over the history of CalCOFI, has been occupied essentially continuously since October 2006. Operations on line 80 began in October 2005, and have been continuous since October 2006. The distance between these lines is about 200 km, so a glider can complete the line once every 10 days. Operations on line 90 are currently supported by CORC, and line 80 is supported by SCCOOS. Line 80, in particular has been a nexus of cooperating projects primarily through the NSF-funded California Current Ecosystem (CCE) LTER.

- b. Tier 3 - Expand the Automated Shore Station network

4. Ecosystems, Fisheries and Water Quality

- a. Tier 3 - Connecting the shelf and nearshore regions to assess physical drivers of variability in the coastal environment of southern California

Currently, SCCOOS collects valuable continuous time series of water quality parameters in the nearshore region at several autonomous shore stations within the Southern California Bight and water quality data from the mid-shelf region with CalCOFI cruises and Spray gliders, however, there are no time series observations to connect the outer-shelf and inner shelf regions. This project will acquire and integrate a Fiber Optic Distributed Temperature Sensing (DTS) system to run in parallel with the automated Newport Pier shore station. This continuous 2-D view of temperature has only recently been adapted for oceanographic use, but has shown great promise in the unprecedented resolution of traditionally under-sampled, and therefore aliased, physical fluctuations common along the California coastline. This project would represent the first use of this technology in a long-term monitoring effort. PI Lucas and colleagues were the first adaptors of DTS technology for oceanography (funded by NSF), and PI Davis recently completed a DTS deployment examining cross-shore exchange.

- b. Tier 3 - Integrated outer-shelf to shoreline modeling on the local scale

This project, we will develop local-scale circulation models for specific outer-shelf to shoreline regions that include all the relevant dynamics (rivers, tides, and surface waves) neglected in the current Bight-scale ROMS. A significant gap exists in the current SCCOOS ocean circulation modeling efforts with the operational 3 km horizontal resolution ROMS. Although useful for Southern California Bight regional studies, this resolution is insufficient to adequately model the sector between the shelf-break and shoreline and to do transport and fate studies of coastal materials (e.g., rivers, sewage, oil spills, nearshore HAB).

- c. Tier 3 - Supplement SCCOOS framework with airborne observations of water quality from NASA/JPL Portable Remote Sensing Imaging Spectrometer (PRISM)

This project will complement the existing SCCOOS framework with airborne observations of water quality from the NASA/JPL Portable Remote Imaging Spectrometer (PRISM). PRISM provides a unique

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opportunity to bridge spatial and temporal gaps for in situ and satellite observations, as well as provide validation, to better inform decision-makers and improve understanding of the changing water quality conditions of the coastal ocean in Southern California. Specifically, the utilization of PRISM for on-demand monitoring of water quality in the coastal waters of Southern California to assess episodic events, such as wastewater diversions, storm water and urban runoff, and harmful algal blooms, and also permit longer term monitoring at scales unmatched by the existing observational framework.

d. Tier 3 - Sensing, mapping and spatial modeling krill off southern California

Monitor, map, and model euphausiid crustacean (krill) populations and spatial aggregations (swarms and larger patches) based on continuous underway hydro-acoustic sensing conducted during standard CalCOFI surveys. This work will be based on standard CalCOFI survey procedures and require no changes to the existing CalCOFI program. At present krill (in addition to other forage fish which are the targets of these surveys), are sensed acoustically aboard NOAA research vessels, but these data are not processed to extract the krill signal. With this project krill values will be summarized in increments and stored in a standardized and geo-referenced database. This database will be contributed to SCCOOS, and made publically available using established data portals (e.g., NOAA ERDDAP amongst others).

This work includes SCCOOS scientific partners to integrate our results with information on water quality and climate-ecosystem change and publish results in the peer-reviewed literature. To facilitate this work, as part of this project we will prepare annual krill reports with maps of distribution and abundance for inclusion on the SCCOOS website.

e. Tier 3 - Adding Biogeochemical (CoSiNE) Model to the High-Resolution (3-km) Physical (ROMS) Real-Time Data Assimilation and Nowcast/Forecast

The proposed work will make direct contributions to the SCCOOS mission to enable sustained model nowcasts and forecasts. If successful, this project will position SCCOOS as a leader in real-time data assimilative coupled physical-biogeochemical modeling within U.S. IOOS. The vision of providing real-time information for better fisheries management and response to environmental hazards (e.g. early warning for harmful algae blooms, hypoxic events, and low-pH water intrusions into aquaculture areas) would bring many benefits to the society.

The major objectives of the proposed project include: (1) implementation of the CoSiNE biogeochemical model coupled to the real-time California 3-km ROMS data assimilation and nowcast/forecast system, (2) inclusion of biogeochemical variables in the existing data assimilation framework, and (3) validation of the coupled physical-biogeochemical model against the existing observations. The CoSiNE-13 version will be used and includes phytoplankton, zooplankton, detritus, particulate inorganic matter, macronutrients, dissolved oxygen, total alkalinity, carbon dioxide, dissolved inorganic nitrogen, bacteria, and dissolved organic matter. The final produce includes: (1) six hourly nowcast and 72-hour forecast of biogeochemical and optical variables off the California coast, and (2) peer-reviewed publications of coupled ROMS-CoSiNE model development and validation.

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- i. Tier 3 - Add additional phytoplankton sampling to harmful algal bloom monitoring
SCCOOS would like to expand its phytoplankton monitoring to increase our biological sampling and to improve the understanding of the environmental causes and health effects in California waters.
- f. Tier 3 - Ocean Acidification – Integrated air-sea flux of CO₂
SCCOOS and CalCOFI programs will take the initiative to implement routine CO₂ measurements to their existing sampling stations. This project will add CO₂ measurements to the various components of the integrated ocean observing system in order to better constrain coastal carbon budgets and, in addition, capture and characterize natural variability and ocean change. There are three foundational activities and a development project;
 - i. Maintenance and operating costs required to sustain continuous operation of underway systems operated at the Carlsbad Aquafarm and on the CalCOFI vessel.
 - ii. Data processing required to a) Quality Controlled (QC) the Aquafarm data for real-time display through the SCCOOS website, b) QC cruise data for delivery of to CalCOFI and SCCOOS databases, and c) analyze the QC'ed data for publication.
 - iii. Development and installation of an online calibration setup for pH sensors operating at the Aquafarm and on CalCOFI.
 - iv. Development of an in situ calibration system for the SeapHOx units operating on the CCE moorings.
- g. Tier 3 - Carbonate chemistry measurements for two of the Wrigley Institute's coastal ocean monitoring sites within the Southern California Bight
The USC Wrigley Institute for Environmental Studies (WIES) project will support new carbonate chemistry measurements for two of the Institute's coastal ocean monitoring sites within the Southern California Bight. Data from these programs will be made publically available, integrate into regional SCCOOS 'Climate and Ecosystems' initiatives and ongoing carbonate monitoring efforts, and meet NOAA objectives to enhance national understanding of ocean carbonate dynamics.

The San Pedro Ocean Time-series (SPOT) is a long-term oceanographic monitoring program run by WIES since 1998. Monthly samplings at the SPOT station, located near the midpoint of the San Pedro Channel, assess spatial and temporal variability across chemical, biological and physical ocean parameters. We propose to add important carbonate chemistry data to this time series program. Monthly samples will be taken from six of twelve designated SPOT depths in the midwater channel, spanning from surface waters to 890 m (bottom). By doing so, the program will not only capture carbonate dynamics at this site across time, but also across depth and in correlation with an extensive ongoing high quality oceanographic dataset.

We also propose to collect carbonate chemistry data from the local waters of the Wrigley Marine Science Center (WMSC), located at Big Fisherman's Cove, Catalina Island, which is part of the Blue Cavern State Marine Conservation Area. This location provides easy access to open ocean water far from urban anthropogenic inputs. Monthly samples will be taken from two depths, at locations inside and outside this cove. Carbonate chemistry data will complement concurrent time series oceanographic data

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collections under development by WIES, which will provide public data on temperature, pressure, salinity, chlorophyll, turbidity and dissolved oxygen in the cove.

SPOT data is publically available through a searchable web portal maintained on the WIES website; this dataset is used by research groups worldwide. Data from Big Fisherman's Cove will also be accessible at the web portal. This public database will be the repository for the proposed carbonate chemistry data; data will also be provided to SCCOOS, along with information about sample collection, data acquisition and quality control parameters. The WIES data portals will include interactive plotting capabilities for users to generate time series or vertical profile plots of pCO₂ and other oceanographic variables.

h. Tier 3 - Santa Barbara Biodiversity Observation Network

Time series data on marine biodiversity is collected at great expense, with the expectation that it will improve our capacity for science-based decision-making aimed at protecting natural ecosystems and sustaining the services that they provide. Most monitoring efforts in marine systems target specific sites, habitats or key groups of species, and are not linked, rendering them inadequate to address regional and global shifts in biodiversity and ecosystem services that result from climate change, pollution, fishing, and other regional- to global-scale impacts. Existing but under-utilized technologies have the potential to dramatically expand our ability to assess species change at all scales. Coordination of available tools, development of new techniques and infrastructure, and integration of these components into a cohesive program will significantly advance our knowledge and understanding of the patterns and drivers of change in marine biodiversity.

The recently established Santa Barbara Channel Biodiversity Observation Network (SBC BON) is developing a demonstration system to address these challenges, which were outlined by the Interagency Ocean Policy Task Force National Ocean Policy Priority Objectives. Our focus area is the Santa Barbara Channel, which is one of the most monitored marine systems in the world. Our project has two broad aims: (1) tie existing monitoring efforts together into a coordinated network and (2) fill the gaps in existing programs with new methods for marine biodiversity monitoring. To go beyond describing patterns to forecasting the effects of climate change on marine biodiversity, models linking biodiversity to physical processes are needed. We will begin developing these models, but in the long term the scientific and management communities need a sustained time series of biological data to complement the extensive physical data collected by IOOS. As the Regional Association of IOOS for southern California, SCCOOS is well positioned to begin linking to SBC BON products, enabling prediction of ecological change in response to climate and other variables.

i. Tier 3 - Collect marine mammal acoustic data along SCCOOS glider lines

The objective of this project is to collect acoustic data along the SCCOOS Spray Glider lines to study of underwater sound from marine mammals. Passive acoustic monitoring is conducted at five fixed-sites in the Southern California Bight, under sponsorship of the Navy and NOAA. These data are analyzed for marine mammal calls as well as anthropogenic noise such as ships and sonar to provide information on the ecosystem role of marine mammals and potential impacts from anthropogenic activities. These fixed sites provide excellent temporal coverage, but limited spatial coverage. By collecting acoustic data using the SCCOOS Spray Gliders, we would have improved spatial coverage and better sample the

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California Current ecosystem. These data would be made available and integrated with other ecosystem monitoring aspects of SCCOOS.

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