



**FY 2011 Implementation of the U.S. Integrated Ocean Observing System (IOOS)**  
Southern California Coastal Ocean Observing System (SCCOOS)  
National Oceanographic Partnership Program Report:  
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Farallon Institute for Advanced Ecosystem Research  
University of California, Los Angeles (UCLA)  
University of California, Santa Barbara (UCSB)  
University of Southern California (USC)

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[www.sccoos.org](http://www.sccoos.org)

**LONG-TERM GOALS**

The Southern California Coastal Ocean Observing System (SCCOOS) is one of eleven regions that contribute to the national U.S. Integrated Ocean Observing System (IOOS<sup>®</sup>). The regional observing systems work to collect, integrate, and deliver coastal and ocean observations in order to improve safety, enhance the economy, and protect the environment. The primary goal of SCCOOS is to provide the scientific data and information needed to inform decision-making and better understand the changing conditions of the coastal ocean in Southern California.

**OBJECTIVES**

SCCOOS has aligned its priorities and objectives with the focus areas designated by U.S. Integrated Ocean Observing System (IOOS<sup>®</sup>), as identified by users and stakeholders throughout the nation.

- **Ecosystems and Climate:** to monitor ocean climate trends and environmental changes in the Southern California Bight by collecting physical, chemical, and biological variables.
- **Water Quality:** to provide monitoring, tracking, and prediction tools for harmful algal blooms, outfall and storm water plumes, and surf zone contaminants.
- **Marine Operations:** to advance integrated, customized products that are critical for safe and efficient navigation, search and rescue, and oil spill response.
- **Coastal Hazards:** to provide accurate, validated inundation models and information with the long-term goal of improving coastal safety.

## **APPROACH AND WORKPLAN**

### **1.) Scientific/Technical Approach**

SCCOOS operates as a system of partnerships and projects that are facilitated by technical and programmatic staff. Organized by the four focus areas, the SCCOOS scientific and technical approach is based on a system of core ocean observing technologies and the delivery of useful data products and tools. System components include sub-surface ocean observations from underwater gliders, nearshore and coastal measurements, wave measurements and models, pier-based monitoring, satellite imagery, high frequency (HF) radar surface current mapping, and data assimilative ocean modeling. The projects described in this report represent the multi-disciplinary and collaborative efforts of the research teams that contribute data and information to SCCOOS.

### **Data Quality Requirements**

SCCOOS will continue to provide access to high-quality integrated data and support regional user needs while complying with the standards and protocols for sharing and archiving data that are developed nationally. SCCOOS actively participates in IOOS Data Management efforts such as the Thematic Real-Time Environmental Distributed Data Services (THREDDS). By leveraging the Coastal Data Information Program (CDIP) and the HF Radar National Network programs, SCCOOS will target THREDDS distribution for both wave and surface current data. SCCOOS participants also contribute to ongoing efforts to develop quality control standards for waves and HF radar-derived surface currents. SCCOOS is progressing towards a standards-based foundation for DMAC capabilities by converting HF radar and shore station formats into NetCDF and THREDDS. SCCOOS has leveraged USACE wave data that are decimated to the NDBC for ingestion into WMO GTS. Wave and current data have associated XML and FDGC compliant metadata.

### **2.) Partners**

#### **California Polytechnic State University, San Luis Obispo**

Dean Wendt manages the array of six HF radar sites for the central California coast and oversees the HAB water sampling program off the Cal Poly Pier in San Luis Obispo Bay.

#### **Farallon Institute for Advanced Ecosystem Research**

William Sydeman oversees shipboard observations of the distribution and abundance of marine birds and mammals, conducted three times yearly in conjunction with the California Cooperative

Oceanic Fisheries Investigations (CalCOFI) Long-Term Ecological Research (LTER) ship surveys.

### **Scripps Institution of Oceanography (SIO), University of California, San Diego**

Spray underwater glider operations are conducted by Daniel Rudnick and Russ Davis of the Instrument Development Group. Ralf Goericke manages the nine stations that comprise the nearshore component of the CalCOFI Program. John McGowan and Melissa Carter collect and analyze water samples to monitor HABs at the Scripps Pier. Robert Guza and William O'Reilly conduct coastal hazards projects in order to develop validated, customized warnings of wave and tide-induced coastal inundation. Eric Terrill serves as Technical Director, with his team at the Coastal Observing Research and Development Center, operates and maintains the HF radar systems and automated shore stations as well as the data management component. Julie Thomas serves as SCCOOS Executive Director and provides wave data and models from the CDIP buoys in Southern California.

### **University of California, Los Angeles (UCLA)**

Rebecca Shipe conducts the HAB monitoring program at Santa Monica Pier. Jim McWilliams, Oceanic Research Group, and Yi Chao, Jet Propulsion Laboratory, develop the Regional Oceanic Modeling System (ROMS).

### **University of California, Santa Barbara (UCSB)**

Libe Washburn manages the operation of HF radar systems in the Santa Barbara region, and along with Mark Brzezinski, oversees the HAB monitoring program at Goleta Pier and Stearns Wharf.

### **University of Southern California (USC)**

Burt Jones manages the HF radar systems and coastal glider operations for discharge plume tracking and HAB detection; he collaborates with David Caron to lead the HAB monitoring program in San Pedro Bay, specifically the collection of water samples at the Newport Beach Pier.

## **3.) Workplan**

In FY2012, SCCOOS will continue its core observations and expand data products when possible within budget constraints. SCCOOS is also committed to contributing to larger ocean observing efforts regionally, nationally, and internationally.

### **Ecosystems and Climate:**

- Operate, support, and maintain network of three glider lines to collect measurements of temperature, salinity, chlorophyll, current velocity, and acoustic backscatter; deliver data to SCCOOS website and push to modeling centers.
- Add sensors for dissolved oxygen to gliders to monitor hypoxia and ocean acidification. The integration of dissolved oxygen sensors on the gliders is proceeding for the purpose of monitoring hypoxia in coastal waters. The dissolved oxygen data also allow an estimate of parameters relevant to ocean acidification through proxy relationships. Using relationships developed by scientists at Scripps Institution of Oceanography, NOAA Pacific Marine Environmental Laboratory, Universidad Autonoma de Baja California, and University of Washington, the glider data have been used to estimate pH and aragonite saturation. Aragonite is important to organisms that form shells, as saturation levels below one may lead to dissolution of the shells.

- As part of CalCOFI-LTER program, measure variables in nearshore region including temperature, salinity, zooplankton, phytoplankton, fish eggs and invertebrate larvae.
- Conduct shipboard observations three times yearly to count seabirds and marine mammals in conjunction with CalCOFI-LTER surveys. Data, products, and modeling page display results on SCCOOS website. Publish survey reports and maps of species' distribution and abundance on SCCOOS web site.
- Conduct automated sampling at four shore stations of temperature, salinity, chlorophyll, turbidity, and water level.
- Meteorological stations provide wind speed and direction, air temperature, sea surface temperature, barometric pressure, humidity, and rainfall levels.

#### **Water Quality:**

- Monitor HABs at six pier stations by collecting weekly measurements of temperature, salinity, chlorophyll, nutrients, and toxic species; distribute data.
- Expand HABs website to include Central and Northern California.
- Continue automated sampling at four shore stations to measure temperature, salinity, chlorophyll, turbidity, and water level.
- Implement the 3-km California statewide ROMS ocean forecasting system for real-time operations and conduct a systematic validation of the model.
- Analyze pollution dispersal in finescale, nearshore, and shelf ROMS for the San Pedro and Santa Monica Bays.
- Provide HF radar-based trajectory tracking tool for Tijuana River Plume.

#### **Marine Operations:**

- Operate and maintain the network of short, medium, and long range HF radar systems and deliver data streams to the National HFR Network. Display surface current maps and tools online.
- Provide Weather Research & Forecasting Model (WRF) wind and precipitation forecasts online from the UCLA Department of Atmospheric and Oceanic Sciences, Climate Sensitivity Research Lounge.
- Maintain integrated map displays for ports and harbors with multi-layered views of near real-time surface currents, wave nowcasts and forecasts, and nautical charts.
- Deliver ocean current data and surface wind analyses to aid oil spill and Search and Rescue (SAR) real-time recovery and post-analysis trajectories.
- Operate and maintain the customized, interactive map display of ocean conditions and forecasts for the Port of Los Angeles and Long Beach Harbor is used to improve navigation, safety, and efficiency for commercial vessels, harbor pilots, and port operations.

#### **Coastal Hazards:**

- Validate and refine inundation models based on surveys of beach sand and water levels.
- Expand online development and integration of inundation information.

### **WORK COMPLETED & RESULTS**

U.S. IOOS regional awards were finalized by the National Oceanic and Atmospheric Administration (NOAA) in late August 2011, so work on this award is still ongoing.

### **IMPACT AND APPLICATIONS**

#### **National Security**

- Ocean conditions, surface currents measurements, and surface wind analyses can be used to aid in spill response as well as generate trajectories to inform search and rescue (SAR) operations.
- Customized, interactive map displays of ocean conditions with multilayer views of observations, nowcasts, and forecasts can improve navigation and safety for military regions and testing ranges.
- Ocean observing data can be used to inform and validate ocean models used by the military and federal agencies.

### **Economic Development**

- Customized, interactive map displays of ocean conditions can improve navigation, safety, and efficiency for commercial vessels, harbor pilots, and port operations.
- Accurate forecasts, measurements, and reports of water quality, for coastal pollutants and harmful algal blooms, inform beach closures and warnings which can affect tourism revenue and the local economy.
- Coastal data and forecast models of erosion, flooding, and inundation levels can be used to protect and improve beaches, real estate, and highways.

### **Quality of Life**

- Tracking impacted or polluted sources such as rivers and sewage outfalls can influence public health and ecosystem health (Areas of Special Biological Significance and marine protected areas).
- Analyze pollution dispersal in finescale, nearshore, and shelf ROMS for the San Pedro and Santa Monica bays.
- Operate and maintain long-term time series of physical, biological, and chemical ocean data are critical in monitoring climate trends and determining ecosystem health.
- Physical and ecological ocean patterns and processes constitute valuable information for Coastal and Marine Spatial Planning and marine protected areas monitoring. Under the auspices of SCCOOS, the California Current Ecosystem Long Term Ecological Research (CCE\_LTER) program, and in conjunction with the California Cooperative Ocean Fisheries Investigation (CalCOFI), the distribution and abundance of seabirds during 3 seasonal surveys were studied.

### **Science Education and Communication**

- SCCOOS ocean data can inform classroom curriculum and informal education programs.
- SCCOOS data visualizations can provide a larger, environmental context for aquariums, science centers, and coastal tourist locations.

## **TRANSITIONS**

### **National Security**

- Implementation of surface currents measured by the SCCOOS HF radar network are now accessible by U.S. Coast Guard for search and rescue (SAR) applications using their Environmental Data Server.
- The live feed of HF radar data are now available on the national HFR network for oil and hazardous spill response in the Environmental Response Management Application® (ERMA) map viewer for the southwest region. Near real-time and archived surface current measurements have been used in the National Preparedness for Response

Exercise Program (NPREP) drill scenarios led by the U.S. Coast Guard in San Diego, Los Angeles, and Ventura.

- Surface current measurements and surface wind analyses are integrated into the General NOAA Operational Modeling Environment (GNOME) for oil spill trajectory analysis.
- Customized and expanded interactive map displays of wave and surface currents with multi-layered views of observations, nowcasts, and forecasts were developed for Naval Air Systems Command (NAVAIR), Point Mugu.
- Glider data are provided to the Naval Oceanographic Office (NAVO) for assimilation into operational models.
- Annually provide training to first responders of maritime incidences in the use of SCCOOS products.

### **Economic Development**

- The customized, interactive map display of ocean conditions and forecasts for the Port of Los Angeles and Long Beach Harbor is used to improve navigation, safety, and efficiency for commercial vessels, harbor pilots, and port operations.
- CalCOFI incorporates measurements from the nine nearshore stations, supported by SCCOOS, into the long-term CalCOFI time series used to inform fisheries management.
- Use surveys of sand levels on beaches and monitor storm inundations at selected locations to validate and refine coastal data and forecast models of erosion, flooding, and inundation levels can be used to protect and improve beaches, real estate, and highways.
- SCCOOS recently signed a Memorandum of Understanding with CeNCOOS and NANOOS to expand and strengthen coordination at the West Coast scale, which will enhance efforts to contribute ocean observing information to regional management efforts including coastal and marine spatial planning and the West Coast Governors' Agreement on Ocean Health.
- The West Coast Ocean Observing Systems (SCCOOS, CeNCOOS and NANOOS) and the West Coast Governors Alliance on Ocean Health (WCGA) signed a Memorandum of Understanding in October 2012 to advance the effective management of coastal and ocean resources on the West Coast. The MOU, signed by the state governments of California, Oregon and Washington and by the directors of SCCOOS, CeNCOOS and NANOOS, provides a formal mechanism for ensuring that the organizations' collaborative efforts are responsive to the comprehensive West Coast stakeholder community and incorporate the best available ocean observation-based information.

### **Quality of Life**

- The SCCOOS HAB program contributes to the statewide HAB Monitoring and Alert Program (HABMAP) initiated by NOAA, the California Ocean Science Trust, and the Southern California Coastal Water Research Project (SCCWRP). The HAB program generates a baseline time-series of ocean properties to monitor ocean conditions in the very near shore zone of the Southern California Bight. These measurements are used to develop forecast models for short term warnings. They also increase our knowledge of the sign, frequency, and magnitude of variation of temperature, salinity, density, nutrients, and pollutants.
- In conjunction with autonomous glider and boat sampling *Pseudo-nitzscha* blooms that produce domoic acid are being monitored. The Caron lab is responsible for the analysis of domoic acid from the 5 SCCOOS HAB monitoring sites.
- Fine-scale simulations with ROMS are being analyzed at UCLA to examine two phenomena. First, pollution effluent dispersal from the Orange County and Hyperion

discharge outfalls we examined. This includes alternative near shore outfalls planned in the coming years. The second examined area was a storm river plume dispersal near Santa Barbara. In both situations the material stays mainly on the continental shelf and slope, and the near shore outfall materials stay very near the coast.

- Weekly reports are derived from a year long time series of sampling for HAB species and related water quality measurements and are provided to the California HAB Monitoring and Alert Program Group.
- The County of San Diego's Department of Environmental Health uses the SCCOOS Tijuana River Plume Tracker to inform water quality warnings and beach closures.
- The YMCA Camp Surf in Imperial Beach uses the SCCOOS Tijuana River Plume tracker, HABs data, and CDIP swell model to help make decisions about the campers' health and safety.
- SCCOOS is working closely with staff from the California Ocean Science Trust's Marine Protected Area Monitoring Enterprise on the development and successful execution of a monitoring program for Southern California's newly established network of marine protected areas.

### **Science Education and Communication**

- SCCOOS ocean data can inform classroom curriculum and informal education programs.
- In partnership with SCCOOS PIs and staff members, the Centers for Ocean Sciences Education Excellence (COSEE)-West and University of Southern California Sea Grant educators conduct an education program for HABs, Ocean Observing Systems Institute for teachers, and multiple online workshops.
- Conducted by the Ocean Institute, the 5<sup>th</sup> grade "Weather and Water" school program is based on SCCOOS meteorological data and meets Earth Science Standards on the water cycle and weather.
- SCCOOS surface currents are featured on an interactive touch-screen kiosk at the Birch Aquarium as part of "Boundless Energy," an exhibit on sources of renewable ocean energy.
- Memorandum of Understanding (MOU) with NANOOS, CeNCOOS, & SCCOOS.
- Memorandum of Understanding (MOU) between NANOOS, CeNCOOS, SCCOOS, and the West Coast Governors Alliance (WCGA).
- SCCOOS has recently signed, and have finalized a Memorandum of Understanding with CeNCOOS and NANOOS to expand and strengthen coordination at the West Coast scale, which will enhance efforts to contribute ocean observing information to regional management efforts including coastal and marine spatial planning and the West Coast Governors' Agreement on Ocean Health.
- SCCOOS data is included in the Channel Islands National Marine Sanctuaries Interactive Touch Screen Kiosk Program.
- Provide ocean observing system training for State and Regional Water Resources Control Board staff, in partnership with CeNCOOS.

### **RELATED PROJECTS**

The State of California Areas of Special Biological Significance (ASBS) system:

<http://www.sccoos.org/data/asbs/?p=20>

California Cooperative Oceanic Fisheries Investigations (CalCOFI): SCCOOS added a cruises section to their data, products, and modeling page with the intention of making it easier for the

user of this information to access the most current data. There is an overview of CalCOFI cruises and SCCOOS involvement as well as a link to the most current cruise data on bird and mammal distribution. <http://sccoos.ucsd.edu/data/cast/calcofi/> <http://calcofi.org>

Centers for Ocean Sciences Education Excellence (COSEE): <http://www.cosee.net>

Coastal Data Information Program (CDIP): <http://cdip.ucsd.edu>

Coastal Observing Research and Development Center (CORDC): <http://cordc.ucsd.edu>

El Nino Project Page: The Spray glider lab, headed by Dan Rudnick, has calculated a "SoCal Niño Index" For comparison the "Oceanic Niño Index" published by NOAA and the indices are remarkably correlated <http://www.sccoos.org/data/elnino/>

Farallon Institute for Advanced Ecosystem Research: <http://www.faralloninstitute.org>

Meteorological Assimilation Data Ingest System (MADIS): <https://madis-data.noaa.gov>

Orange County Sanitation Department (OCSD <http://www.ocsd.com/>) diverted flow from their 120 inch outfall pipe just 4.5 miles offshore to a 78 inch outfall pipe 1 mile offshore from September 11, 2012 to October 1, 2012. SCCOOS developed a project page (<http://www.sccoos.org/projects/ocsd-diversion/>) to update the public on the overview and history of the project as well as environmental support data for the OCSD diversion. Orange County Sanitation Department (OCSD) diverted flow from their 120 inch outfall pipe just 4.5 miles offshore to a 78 inch outfall pipe 1 mile offshore from September 11, 2012 to October 1, 2012. SCCOOS provided a real-time mooring and data for high frequency radar (HFR) trajectories. SCCOOS and Central and Northern California Coastal Ocean Observing System (CeNCOOS) will synthesize the results of the diversion's modeling and monitoring for a technical review of those activities as well as the results highlighting successes, failures, and lessons learned. The synthesis report will provide the foundation for further technical review as to the effectiveness and efficiency of the overall plan.

SCCOOS Ocean Acidification Page: SCCOOS developed an ocean acidification (OA) page to help inform any user about what OA is, what the potential impacts are, what SCCOOS is doing, who the partners are, what their technology are, and what their data are. This project page is updated as progress occurs. <http://www.sccoos.org/projects/2012OA/>

State Water Resource Control Board (SWRCB): <http://www.swrcb.ca.gov/>