FY 2014 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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1) PROJECT SUMMARY

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®). 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.

SCCOOS has aligned its priorities and objectives with the focus areas designated by U.S. Integrated Ocean Observing System (IOOS®), 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.

- **Science Education and Communication:** to provide a way for the public to learn, educate, and promote scientific research using data obtained from SCCOOS.

2) PROGRESS AND ACCOMPLISHMENTS

SCCOOS continues to have the ability to achieve its milestones by providing 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 wave, surface currents, and shore station data. SCCOOS participants also contribute to ongoing efforts to develop quality control standards for waves and HF radar-derived surface currents. Wave and current data have associated XML and FDGC compliant metadata.

The following goals/milestones have been met.

Ecosystems and Climate:
- Underwater glider surveys collect offshore measurements of temperature, salinity, chlorophyll, and current velocity.
- Dissolved oxygen sensors have been added 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.
- Meteorological stations provide wind speed and direction, air temperature, sea surface temperature, barometric pressure, humidity, and rainfall levels.
- In support of the West Coast shellfish Industry a pCO_2-DIC system called the Burkolater has been installed at the Carlsbad Aquafarm to accelerate ocean acidification technology transition into operation in the Pacific.

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:
- 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.
- 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.
- 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.
- Surface current measurements and surface wind analyses are integrated into the General NOAA Operational Modeling Environment (GNOME) for oil spill trajectory analysis.

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

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.
- SCCOOS regularly participates in tours, workshops, and meetings within southern California in order to further collaboration and provide data and information when requested.
- Lisa Hazard, a SCCOOS Ex-Officio Advisor Participated in an Ignite session at the IOOS fall meeting in Washington D.C.
- On July 1 CeNCOOS and SCCOOS hosted a Marine Symposium entitled, "Ocean Observations along California's Central Coast in a Changing Climate". An audience of the marine and coastal stakeholder community was in attendance and actively engaged our panels in discussions regarding ocean observations and their practical applications.
- SCCOOS, CeNCOOS and NANOOS is jointly hosted a one-year fellowship with the West Coast Governors Alliance (WCGA) Regional Data Framework (RDF) that began November 2013 and ended October 31, 2014. This West Coast Oceanographic Data Integration Fellow, Laura Lilly, was located at the SCCOOS program office at Scripps Institution of Oceanography in La Jolla, CA. The fellow focused on the identification of priority regional management questions and information needs to be

informed by West Coast oceanographic data products and the development and distribution of those products.

U.S. IOOS regional awards that are ongoing.

Ecosystems and Climate
- Operate and maintain the network of short, medium, and long range HF radar systems and deliver data streams to the National HFR Network.
- Operating and maintaining 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.
- Publish survey reports and maps of species' distribution and abundance on SCCOOS web site.
- 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.
- Conduct automated sampling at four shore stations of temperature, salinity, chlorophyll, turbidity, and water level.
- Seabirds are identified and counted while at sea during the winter, spring, and summer CalCOFI surveys. The survey reports and maps of species' distribution and abundance on SCCOOS web site.
- 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.
- Maintain and validate the pCO_2-DIC system (Burkolator). Train a representative at the Carlsbad Aquafarm to operate and maintain the prototype instrument. Begin development of data management and communication for data collection, quality control, quality assurance, and data archive. Initiate the IOOS marine sensor program with the long-term goal of creating a sustainable and coordinated U.S. West Coast wide ocean acidification effort.

Water Quality
- 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.
- 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.
- 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.
- 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.

- 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.
- 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.

Marine Operations
- 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.
- Customized, interactive map displays of ocean conditions can improve navigation, safety, and efficiency for commercial vessels, harbor pilots, and port operations.
- 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.
- 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.

Coastal Hazards
- Expand development and integration of inundation web site.
- Develop Shoreline inundation forecast, validation, and dissemination of warnings.
- 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.

Science Education and Communication
- There are ongoing collaborations with the West Coast OOSes (Ocean Observing Systems) and the West Coast National Marine Sanctuaries to bring in real-time data in support of West Coast wide education and outreach of our coasts and ocean.
- San Diego International Airport has commissioned Jason Bruges Studio to create an exciting and innovative lounge for passengers as part of the airport's Terminal 2 expansion and on- going arts program. The "AirSpace" or "New Media Lounge", and will be designed to reflect the landscape, terrain, cliffs and coastal areas surrounding the airport. The studio is working closely with SCCOOS to use our near-real time data combined with biological data from Dept. of Fish & Wildlife, NOAA Southwest Fisheries Science Center, and Scripps institution of Oceanography to provide perspective on themes such as the environment and sustainability.

3) SCOPE OF WORK

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.

4) PERSONNEL AND ORGANIZATION STRUCTURE
- SCCOOS replaced their government and public relations coordinator. Chris Cohen was replaced by Jen McWhorter.

5) BUDGET ANALYSIS
In FY 2014, SCCOOS received an increase of funds of $93,000 from FY13. The SCCOOS Executive Steering Committee (ESC) have designated that the additional funds were allocated to Regional Association (RA) Organization and Education/Outreach ($43,786) and to manage SCCOOS Data Feeds and Outside Data Integration, Data Delivery, Online products, IOOS DMAC, Website ($49,214). The remainder of SCCOOS projects received level funding from FY13.

FY14 funding will provide a valuable investment in important assets and will strengthen regional partnerships and national program planning. 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.

Expenditures are progressing as expected, with no major discrepancies between actuals and budgeted on both the main award and the subawards.

6) ANNUAL SUPPLEMENTALS

Products and Services
- During Sept. 11—October 2, 2012, OCSD diverted their wastewater outfall to inspect, assess, and rehabilitate the infrastructure. In preparation of this OCSD funded a large effort to suss out the fate and transport of effluent at-depth. CeNCOOS and SCCOOS received funding to compile a summary and lessons learned report, and finalized this task this year. The project as a whole was evaluated through-out the various stages of planning data collection, modeling, product development, reporting, and conclusions in order to identify the most useful and cost-effective methods to predict and mitigate environmental issues related to the diversion.
- Laura Lilly is the new Sea Grant fellow for SCCOOS, CeNCOOS and NANOOS with the West Coast Governors Alliance (WCGA) Regional Data Framework (RDF). This one-year West Coast Oceanographic Data Integration Fellowship began November 2013. Ms. Lilly will sit at the SCCOOS program office at Scripps Institution of Oceanography in La Jolla, CA. She will focus on the identification of priority regional management questions and information needs to be informed by West Coast oceanographic data products and the development and distribution of those products. The fellowship was administered by California Sea Grant.
- SCCOOS incorporated information management into the management our local ASBS (Areas of Special Biological Significance). This new portal is a critical tool to efficiently assess and manage regulatory programs. Information management systems can display data in the interrelated language that biological-physical-chemical processes present in the watershed and marine environment. These data can then be assessed and available to a wide range of users that span both regulatory and non-regulatory based data collection efforts. Our goal was to design a modular problem driven application that builds upon different standards and protocols. We strived to emulate existing ocean observing systems web portals for ease of navigation and familiarity. Utilizing open standard formats and protocols enables

access to varying structures and distributed data sources. Since some of the data shown on the website is derived from other sources, the goal has been to access services or data directly instead of hosting copies. This format allows for varying data types enabling a customized portal. The data layers that are included in online tool are grouped by near-real time observations, static point observations, and spatial observations/models. The online tool (http://www.sccoos.org/data/map/asbs.html), was designed to establish the infrastructure needs and generate a conceptual design that is required for long term assessment of ASBS performance and related management decisions. The system will expand upon the current information management framework developed by UCSD/SIO for the La Jolla Shores Coastal Watershed Management Plan. Local and regional information sharing initiatives are promoted, and support low impact development (LID), water conservation, and public engagement through outreach and data visualization. The end-product develops a usable information system for a range of users.

- SCCOOS Principle Investigator, Dan Rudnick, has been leading the effort of tracking the potential of an El Niño to inform preparation efforts in Southern California. Dan and program staff at SCCOOS has been participating in El Niño bi-monthly conference calls with partners within NOAA to coordinate efforts and data collection. An article relating to this story can be found at: https://scripps.ucsd.edu/news/el-ni%C3%B1o-shaping-southern-california.

Data Management
- SCCOOS has completed a standards-based foundation for DMAC capabilities by converting HF radar and shore station formats into NetCDF and THREDDS.
- SCCOOS has released ncSOS service for its automated and manual shore stations.
- SCCOOS has leveraged CDIP wave data that are decimated to the NDBC for ingestion into WMO GTS
- Ongoing program-level participation in data management planning and coordination activities are;
  - Sarah Hiem & Grant Cameron attended a THREDDS training workshop on behalf of SCCOOS October 20-24, 2014
  - Darren Wright attended a Beach Water Quality Work Group on August 14, 2013.
  - Darren Wright, Jen McWhorter and Laura Lilly attended the West Coast Ocean Data Portal Regional Data Framework meeting November 3 & 4, 2014.
  - Jen McWhorter attended the 2014 ESRI Ocean GIS Forum in Redlands November 4-7.
- Julie Thomas and Darren Wright participate in ongoing program-level data management because she is on the committee for IOOS DM standards.
- Julie Thomas participates in the Joint Planning DMAC.
- Julie Thomas participates in the ongoing IOOS maturity levels and certification standards with her Ocean Observations Initiative (OOI) and IOOS DM collaborations.
- Darren Wright hosted Jenn Patterson from CeNCOOS at Scripps Institution of Oceanography.
- Darren Wright presented SCCOOS and CDIP data management quality control during an IOOS Webinar

Observation Assets
- SCCOOS received funding for IOOS's ocean acidification marine sensor program. SCCOOS/SIO will operate a "Burkalator" pCO2 analyzer at Carlsbad Aquafarm, to track ocean acidification impacts on shellfish aquaculture. Lessons learned from these operations will be applied to future coastal measurements of ocean acidification. All Burkolator's can be found at: http://www.ipacoa.org/.
- A newly deployed CDIP San Pedro South Buoy and customized website, funded by the U.S. Integrated Ocean Observing System (IOOS), will be used operationally by Jacobsen Pilots for validating oceanographic conditions to ensure the safe transport of vessel traffic transiting at the Port of Long Beach. This buoy is one component of a larger project to ascertain the Under Keel Clearance (UKC) of commercial vessels. In collaboration with federal, state and industry partnerships, the Dutch company PROTIDE will develop a model that provides the UKC information. With funding from the Oil Spill

Prevention and Response (OSPR) for the initial assessment, The Marine Exchange of Southern California in San Pedro will serve as the management entity for this project. Wave data are extremely important during a high swell event. Vessels can pitch and roll, affecting their draft and potentially hitting the ocean bottom. Combined, the Port of Los Angeles and the Port of Long Beach are the busiest ports in the United States for vessel transport. Assuring the safety and operations of vessel traffic is a vital component to our nation. The IOOS funding for this buoy is in collaboration with the US Army Corps of Engineers and the California Department of Parks and Recreation.