Southern California Coastal Ocean Observing System (SCCOOS)

Operational Plan 2016

Purpose

The Operational Plan contains the SCCOOS annual work plan as a supplemental document to the Strategic Operational Plan 2016-2021. This plan is updated on an annual basis or more often if needed.

Governance and Management

Working closely with the IOOS Program office, SCCOOS will continue to effectively manage the finances and logistics for contracts and governance. In addition, partnerships will continue to be developed at the local, regional, national and international levels, including statewide collaborations with the Central and Northern California Ocean Observing System (CeNCOOS). This project-based approach ensures effective stakeholder engagement.

Focus Areas

Development of U.S. Integrated Ocean Observing System (IOOS) funded infrastructure and methodology used to collect, analyze and disseminate observations in near real-time will continue.

1) Marine Operations

HIGH FREQUENCY RADAR

There are 28 first priority High Frequency (HF) radars supported within this next funding cycle and 5 second priority HF radars, supported with best efforts including location, approximate operating frequency, and how the HF radars will operate within the national network. SCCOOS will continue to provide training to the first responders of maritime incidences for real-time products.

WAVE OBSERVATIONS AND WAVE MODELS

SCCOOS will continue to work on the Under Keel Clearance project at Long Beach by operating the two critical validation wave buoys. SCCOOS will also continue to collaborate with the Naval Air Warfare Center at Point Mugu, and in support of homeland security, expand the near real-time, customized wave and surface currents display with additional areas of interest as provided by the Navy (sccoos.org/data/harbors/navair/fullscreen.php). We will also continue to serve as principal authors in the updating of the IOOS National Wave Plan.[1],

OFFSHORE ENERGY

Currently, there are no permitted renewable offshore energy sites, including wind and wave sites and tidal energy, at this time in California. Little information is presently available concerning the potential impacts such activities might have to both the physical and biological environment. A number of efforts

[1] National Operational Wave Observation Plan, 2009. http://ioos.gov/library/wave_plan_final_03122009.pdf

were initiated and then failed to launch mainly due to uncertainties in the technology and significant state and federal regulations. However, momentum and interest remains and representatives from the Ocean Observing Systems serve on the California Marine Renewable Energy Working Group. At this time, we have identified ourselves as a resource for wave data, wave models, surface currents, and data management. The information and/or products we could provide depend greatly on the proposed locations of offshore energy sites and the type of technology chosen. The technology would have to prove efficient and reliable though for SCCOOS to invest time and resources in supporting this effort.

Milestone Schedule

Year 1-5 Upgrade and/or replace HF Radar hardware as needed (as resources become available)
Year 1-5 Track developments of offshore energy and maintain communications with partners.

2) Coastal Hazards

A site-specific model for tide and wave-driven inundation will be calibrated with field observations of shoreline water level acquired during previous winter storms. Existing data streams will be used to estimate and forecast water level and wave conditions seaward of the surfzone. Existing observations of shoreline water level, waves and inundation will provide the inundation model calibration required for issuing localized warnings for highway closures and sand-bagging. National Oceanic and Atmospheric Administration (NOAA) tide gauges provide water level, including the astronomical tides, storm surge, El Niño and other regional factors.

The Coastal Data Information Program (CDIP) coastal wave model Monitoring and Prediction System (MOPS), developed with SCCOOS support, includes both remotely generated swell and locally generated seas, and yields nowcast and forecast models of waves on the 10 m depth contour, immediately offshore of the surfzone with high temporal (hourly) and spatial (100 m alongshore) resolution. Offshore boundary conditions are provided by the CDIP network of wave buoys and co-located point forecast spectra from the NOAA Wave Watch III global wave model. Field testing in Southern California Bight has extensively validated MOPS. Simple inundation models[2] relate the uprush limit to tide level, and wave height and period[3]. These models, used in the existing CDIP inundation forecasts, yield qualitative water level information but do not include site-specific beach morphology. The vertical elevation reached by storm waves depends on the beach slope, which varies seasonally and spatially. Also, the elevation levels in the presently distributed models (38 sites) do not include the effects of local bathymetry. Local bathymetry will be included at five focus sites. Inundation thresholds, meaning the vertical elevation required to cause particular impacts, are lacking in the presently disseminated warnings except for the Cardiff site.

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[2] Ruggiero, P., Holman, R.A. and Beach, R.A., 2004. Wave run-up on a high-energy dissipative beach. Journal of Geophysical Research-Oceans, 109(C6).

[3] Stockdon, H.F., Holman, R.A., Howd, P.A. and Sallenger, A.H., 2006. Empirical parameterization of setup, swash, and runup. Coastal Engineering, 53(7): 573-588.

Past observations of water level, waves, and overtopping/street flooding with beach profiles coupled will allow site-specific, customized, inundation warning. Stakeholder recommendations for monitoring and modeling to improve product confidence and accuracy will be incorporated. The end-users will provide the feedback on the accuracy and format of the models and warnings, as well as contribute qualitative observations acquired by their staff. Model predictions will improve with more documented observations of flooding events. The sites chosen for inundation modeling were selected on the basis of access, severity of inundation, logistical support from local agencies and other factors. Website content (e.g., bathymetric surveys, inundation observations, tides, MOPS nowcasts and forecasts, model improvements) and warning messages will be updated at all sites as information and model improvements become available.

Milestone Schedule
Year 1-2: Compile database of historical bathymetry surveys. Develop model for Newport and Seal Beaches. Collect coastal flooding images through citizen science.
Year 3-5: Develop a model for Huntington and Imperial Beaches.

3) Climate Variability and Change

SCCOOS is committed to and prioritizes sustained data collection to provide a reliable climate record of ocean changes. Analyses of these data are intended to produce indices as assessments for ocean and ecosystem health. State-of-the-art models assimilate these data to produce predictions and re-analyses of ocean state. SCCOOS will provide technical and data management support for an end-to-end system from observations to products relevant to the evolving coastal ocean climate and climate variability.

GLIDERS
Sustain the underwater gliders network of ecosystem observations in the Southern California Bight. Gliders have remained a proven and stable platform. Monitoring is accomplished on a series of lines, a round-trip section completed once every two to three weeks. SCCOOS will continue to collect and distribute glider data for assimilation into operational models. We will also continue to work on "Toward a U.S. IOOS Underwater Glider Network Plan"[4].

Milestone Schedule
Year 1-5: Continue to develop, integrate and enhance long-term glider time series products for distribution.

4) Ecosystems, Fisheries, and Water Quality

SCCOOS will support the observations and data life-cycle for the following projects:

CALIFORNIA COOPERATIVE OCEANIC FISHERIES INVESTIGATION (CALCOFI)
SCCOOS will continue to expand the utility of CalCOFI quarterly sampling cruises with the nine stations near the coast. These data connect the offshore CalCOFI time series to the nearshore environment. Long-

[4] "Toward a U.S. IOOS Underwater Glider Network Plan: Part of a comprehensive subsurface observing system", 2014 http://www.ioos.noaa.gov/glider/strategy/glider_network_whitepaper_final.pdf

term changes in marine ecosystems can be indexed by fluctuations in the life history, abundance and demography of top predators. In the Southern California Bight, changes in seabird and mammal breeding success, diet and foraging behavior and abundance are sensitive indicators of ecosystem and food web change[5].

HF RADAR

SCCOOS proposes to begin the synthesis of the HF radar time series to generate indices for ecosystem relevance, focusing on spatial patterns of upwelling and divergence. Maps of connectivity are identified as priorities by the NOAA Southwest Fisheries Science Center biologists examining egg and larvae trends. Estimating biological connectivity is critical to ecosystem management and assessment, particularly for the Marine Protected Areas (MPAs). Seasonally variable urban runoff concentrating in California river discharge impacts coastal areas bringing contaminated flows to regions that may stretch far from sources. In partnership with Southern California Coastal Water Research Project (SCCWRP), SCCOOS conducted a study to examine the potential exposure from 20 southern California storm water discharges[6]. The study used a surface transport model to examine coastal circulation using a two-year optimally interpolated surface current mapping dataset to drive the model. These models provided a quantitative, statistical measure of the spatial extent of the discharge plumes in the coastal receiving waters, defined here as a discharge's ''exposure''. The exposure maps were used to (1) assess the probability of storm water connectivity to nearby MPAs, and (2) develop a methodology to estimate the mass transport of stormwater discharges.

AUTOMATED SHORE STATIONS

SCCOOS will maintain the data collection at 3 pier sites (Scripps, Newport, and Stearns Wharf), measuring daily temperature and salinity. Data are posted, and trend synthesis is ongoing.

HARMFUL ALGAL BLOOMS (HABS)

The HABs program will continue to maintain five pier-monitoring sites posting real-time temperature, salinity and chlorophyll fluorescence data to provide indications of freshwater input, upwelling and algal blooms. Weekly bottle samples measure chlorophyll, nutrients, domoic acid, saxitoxins, and abundances of harmful algal species and other pertinent planktonic assemblages (major phytoplankton and microzooplankton taxa, cyanobacteria, picoplanktonic algae and heterotrophic bacteria). In addition to monitoring the blooms of toxic algal species, other bloom forming species have been tracked at some stations along with nutrients and the entire algal biomass (chlorophyll) at most stations. The purpose of these "secondary" measurements is to establish a long-enough time/space series to determine the sign, magnitude, frequency and size of algal blooms as a first, necessary step in understanding of their nature. This is a requirement to determine their causes and to predict their occurrence. In addition to the success of the HABs early warning system, much has been learned about algal blooms along our coast. There

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[5] Sydeman, W.J. et al. 2009. Seabird and climate in the California Current – a synthesis of change. CalCOFI Reports 50: 82-106.

[6] Kim, S. Y., B. D. Cornuelle, and E. J. Terrill, 2009. Assessing coastal plumes in a region of multiple discharges: the U.S.-Mexico border. Environ. Sci. Technol., 43 (19), 7450–7457, doi:10.1021/es900775p

are now at least two models of blooms ready to be tested, compared and further developed. Thus we are approaching the ability to predict HAB occurrences using independently measured variables.[7]

OCEAN ACIDIFICATION AND HYPOXIA

In addition to the Carlsbad Aquafarm Burkolator data, SCCOOS plans to ingest the data from the Burkolator located at the Wrigley Institute where additional measurements of CO_2 are taken in the San Pedro Bight. SCCOOS will continue with the aggregation and integration of existing and new ocean acidification (OA) data throughout the Southern California Bight.

Milestone Schedule

Year 1: Collaborate and integrate new ocean acidification and hypoxia observations through leveraged partners.
Year 1: Leverage partnership to fund the Santa Monica Pier Automated Shore Station.

5) Data Management and Communications Subsystem

COMPUTING INFRASTRUCTURE

SCCOOS will continue to assure that observational data are stored on reliable servers housed at the Scripps' Co-Location facility. Servers are backed-up nightly and copies stored offsite at the UC San Diego Super Computer Center. To harden disaster/recovery options, migrating to cloud processing and storage is in progress.

DATA INGESTION

SCCOOS will continue to ingest observations are collected from a variety of platforms, each of which has its own level of data processing maturity.

QUALITY CONTROL

SCCOOS plays an active role in the ongoing effort to develop and implement QC standards. SCCOOS has been involved with QARTOD since its inception, and continues to serve on the Steering Committee. SCCOOS SMEs have participated in several QARTOD workshops. Data collection through SCCOOS operated programs such as the Shore Stations and HAB's program will be implementing QARTOD QC testing ideally within the next year. The network Common Data Format (netCDF) files, including the QC flags will be made available through the website. Highly leveraged programs such as CDIP, HFRNet, CalCOFI and Gliders manage their own QC, some of which have already implemented QARTOD QC.

PUBLIC ACCESS AND DISSEMINATION

SCCOOS participates with IOOS partners in a highly distributed system of interoperable components. SCCOOS submits HF radar and glider data to the IOOS DACs for distribution. The HF radar, glider and wave observations are all transmitted to the National Data Buoy Center for inclusion on the GTS. SCCOOS actively participates in on-going DMAC efforts to standardize data distribution through the use of web services such as the Sensor Observation Service (SOS) and the Open-Source Project for a

[7] Feely, RA et al 2008 Evidence for upwelling of corrosive "acidified" water onto the continental shelf. Science 320 1490-1492.

Network Data Access Protocol (OPeNDAP)/Thematic Real-Time Environmental Distributed Data Services (THREDDS). SCCOOS will also target the integration of an Environmental Research Division's Data Access Program (ERDDAP) server which will provide a consistent way to download subsets of gridded and tabular scientific datasets. Certain netCDF files such as those from the HF radar, gliders, Shore Station data and CDIP wave buoys that are registered with the IOOS Service Registry, contain Federal Geographic Data Committee (FGDC) and International Organization for Standardization (ISO) 19115 metadata, and are available through ERDDAP and THREDDS. Registration of datasets and services with IOOS provides basic monitoring of service availability and response time. Once all SCCOOS data are available in netCDF, metadata will be available in both FDGC and ISO 19115 supplementing existing management and query capabilities (keywords and ontologies). SCOOOS will continue to post web metrics, now showing 179,295 page views and 42,076 users in 2014 (sccoos.org/about/dmac/webstats/). In addition to the IOOS base funded tasks, SCCOOS will continue to provide externally funded project specific data management expertise aligned with its recently completed task funded by the UC Environmental Health and Safety in which SCCOOS developed the Coastkeeper's Coastal Champion award winning data portal for the La Jolla Area of Sensitive and Biological Significance (ASBS) site (sccoos.org/data/asbs/?p=20). The Hyperion wastewater diversion project (http://www.sccoos.org/projects/hyperion/), and the Orange County Sanitation District diversion (http://www.sccoos.org/projects/2012-ocsd-outfall-repair-diversion/) continue to provide external funding for data management including additional data ingest and visualization.

ARCHIVE

The long-term data preservation will be at National Center for Environmental Information (NCEI). Presently, CDIP and HFRNet data are archived at NCEI. The next parameters on the list for archive will be those associated with the Shore Stations data.

Milestone Schedule:

Year 1: Ingest, quality control, disseminate and visualize all SCCOOS data streams. Continue to develop and transition to cloud computing.

Year 1-5: Ingest, format and visualize the Publically Owned Treatment Works (POTWs) data from the quarterly hydrographic surveys.

6) Modeling and Analysis Subsystem

Models will be initialized and tested with glider-derived maps of water constituents and currents around POTW outfalls. Validation of the Region Ocean Model System (ROMS) output against non-assimilated observations (e.g. moored ADCP and temperature data) has yielded promising results[8] and additional validation is ongoing to assess the skill of the model in shallow water. Development and validation of finer spatial resolution ROMS is important for better resolving plume dynamics on small scales. The assimilated models will be balanced by forward models forced with re-analysis products to depict the intrinsic variability in oceanic transports. The same wave model used to drive inundation models will be

[8] Dong, C., E.Y. Idica, and J.C. McWilliams, 2009. Circulation and multiple-scale variability in the Southern California Bight. Prog. Oceanography 82, 168-190.

used to model transport by alongshore currents. SCCOOS DMAC is exploring cloud computing for managing the modelling life cycle.

Milestone Schedule

Year 1: Produce re-analysis products using the 3 km ROMS 3DVAR data assimilative nowcast/forecast system from 2009 to present when there is a good HF radar coverage.

7) Outreach, Stakeholder Engagement and Education Subsystem

SCCOOS will continue to leverage partnerships and continue to seek new stakeholder groups to assess information gaps and develop needed products. SCCOOS will continue to collaborate with organizations such as the Maritime Alliance, providing expertise on the Southern California "Blue Economy" maritime industry and serving as a key partner in demonstrating the economic benefit of a regional observing system. SCCOOS will continue to partner with the Scripps Center for Marine Biodiversity and Conservation (CMBC) Masters Program connecting students to various research opportunities.

Conclusion

SCCOOS maintains unique, long-term biological, chemical, and physical observations in the Southern California Bight in order to distribute ocean information of public interest. SCCOOS fulfills U.S. IOOS goals by: (1) identifying trends in the climate environment, and supporting the ecosystem, fisheries and water quality management, (2) informing operational users for marine and national safety, and (3) supporting coastal resiliency by delivering coastal hazard information to coastal managers. SCCOOS has the data framework to provide these critical observations and products for effective life-cycle management of ocean resources critical to the environment in Southern California. SCCOOS has the infrastructure, flexibility, and stakeholder participation necessary to address emerging coastal management issues including desalination and ocean energy. SCCOOS is committed to contributing to larger ocean observing collaborations at the regional, national, and international levels with other RAs, state, federal, and tribal organizations, users, and partnerships, furthering our role as stewards of ocean resources.