Coastal Ocean Currents Monitoring Program (COCMP)
in Southern California
Grant # 04-078

1st Quarter Report 2008
Period of Performance: 1 January 2008 – 31 March 2008

Submitted to the State Coastal Conservancy by the
Southern California Coastal Ocean Observing System (SCCOOS)

INTRODUCTION

The Southern California Coastal Ocean Observing System (SCCOOS) continues the implementation of the Coastal Ocean Currents Monitoring Program (COCMP) for Southern California.

COCMP is a significant component of SCCOOS's efforts to build ocean observing and monitoring capacity for the region. This effort is augmented with federal funding to serve user needs and contribute to the evolution of a comprehensive ocean observational system for both the region and state. SCCOOS continues to coordinate with the Central and Northern California Ocean Observing System (CeNCOOS) to ensure a unified statewide system.

Program tasks include:

   A. Surface Current Mapping (SCM) Array
   B. Nearshore and Surf zone Observations
   C. Subsurface Observations
   D. Regional Ocean Modeling
   E. Data Distribution and Management

This report describes third quarter activities and progress that took place in these task areas.

COCMP EXTERNAL REVIEW

SCCOOS executive committee members Eric Terrill, Burt Jones and Yi Chao participated in the COCMP 2008 Annual Review at the COCMP offices in Oakland on 13 March 2008. Topics covered included updates on infrastructure implementation, licensing and validation issues, RA development plans, and data integration and product development. SCCOOS submitted its 2007 COCMP Annual Report on 8 February 2008.

PROGRESS REPORT BY TASK

TASK A. ESTABLISH SCM ARRAY FOR MAPPING OCEAN CURRENTS

Task A.1 SCM Site Assessment

CalPoly, UCSB, USC and SIO continued efforts on HF radar site assessments and permissions throughout the first quarter of 2008. Newport Beach Pier installation is scheduled for early May and will coincide with a planned maintenance of the Orange County Sanitation District site. Planning for this site has been one of the most comprehensive for the southern California region. A test installation was conducted approximately one year ago to assess the feasibility of successful operation on a pier. Piers tend to significantly distort antenna calibration patterns due to the large amount of metal and concrete used in the building materials. Fortunately, Newport Pier is a wooden pier, which reduces the amount of distortion seen in the receive antenna. Had the pier been unusable as a deployment site, SCCOOS would have had to install two antennas: one antenna to the north and one antenna to the south. The pier extends from a point of land that

would shadow a single antenna either to the north or south. SCCOOS anticipates a smooth installation this coming quarter.

SCCOOS personnel will also be reinstalling the Santa Cruz Island 5 MHz site in early April. The Santa Cruz Island site greatly improves coverage around the Channel Islands as an offshore site. Radials from this location can combine with along coast radials reducing gaps left by straight coastline.

Task A.2 Site Permissions

Permission to install two radars on Camp Pendleton property has been granted, as the Camp Pendleton Assistant Chief of Facilities has approved the license agreement. One HF radar will be installed at the southern end of the property at the Camp Del Mar lifeguard station. The other will be installed at a decommissioned Loran station at San Mateo Point on the northern end of San Onofre State beach. SCCOOS personnel have met with Camp Del Mar lifeguards, and logistical requirements for installation in the lifeguard station are being resolved. A mobile solar power trailer will power the site at San Mateo Point; construction will be completed in May 2008, and installation will follow.

SCCOOS representatives have been working with LA County Lifeguards regarding concerns raised during the installation of three locations: Nicholas Canyon, Dan Blocker, and Dockweiler. SCM systems had been installed near lifeguard facilities at those locations following approval from Lifeguard Authorities. Local lifeguards working at the facilities raised concerns regarding system safety and operation. SCCOOS personnel addressed safety concerns at a meeting held 22 March 2007 at Corral Canyon Beach. While the Dockweiler site became operational immediately, lifeguards at Nicholas Canyon and Dan Blocker remained hesitant. This quarter the city of Malibu has granted a license to operate HF radar at Dan Blocker beach in Malibu. The location of the antenna will be moved from the lifeguard station to a nearby pole, which holds "Watch The Water" web cameras. Re-installation is set for late May. The site at Nicholas Canyon is still under review.

Union Pacific has offered a land lease at Gaviota to UCSB. The agreement is currently being reviewed by UCSD Real estate. UCSB has also made progress on Point Mugu and is close to receiving final approval.

Task A.3 Frequency Allocation

There are no new updates for task A.3. SCCOOS has submitted an FCC license renewal on 18 May 2007. NOAA is pursuing approval and transition of HF radar for mapping surface currents into the permanent frequency band. NOAA has requested several center frequencies with bands in the 25MHz, 13MHz, and 5MHz frequency range. We anticipate that this process will take 4-5 years for approval. SCCOOS will continue to operate under the existing experimental licenses. If the May 2007 renewal is denied, SCCOOS surface current mapping systems will be altered to operate under existing NOAA experimental licenses.

Task A.4 Site Preparation and Equipment Order

The HF radar site at Point Loma Waste Water Treatment plant was installed 31 January 31 2008, and has been providing near real time data to SCCOOS since that time. Issues with radio frequency interference (RFI) on the building's intercom and public address systems were easily resolved by installing ferrites on the speaker cables.

SCCOOS is entering the final quarter for HF radar delivery. By next quarter, SCCOOS will have received all HF radars ordered for this project. SCCOOS personnel continue to purchase supporting equipment as the final sites are installed.

Task A.5 Standard Operating Practices

A workshop conducted 10-13 September 2007 at Scripps Institution of Oceanography brought together representatives of the HF radar technical community from around the nation. The workshop included representatives from the Radiowave Operators Working Group (ROWG). With input from this workshop and previous meetings SCCOOS staff have drafted a working document: *Deployment & Setup of a High-Frequency Radar for Ocean Surface Current Mapping: Best Practices*. This document has been published on the ROWG website with a request for community review and input. This document is version 1.0 of a reference guide for HF radar operators and is supplemental to the manufacture's manuals containing real world practices and examples. Initial feedback has been positive. The document is also available at: http://www.sccoos.org/docs/SCCOOS-BestPractices.pdf.

TASK B. ESTABLISH NEARSHORE AND SURFZONE OBSERVATIONS (HB06)

Task B.1 Wave and Current Observations

Data are continuing to be qa/qc'd by the performers involved in the HB06 demonstration program.

Task B.2 Transition Zone Observations – AUV, Drifter and Mooring Deployment

Surf zone measurements from AUVs, drifters, and moorings were collected during the Huntington Beach 2006 experiment. No further updates at this time.

Task B.3 Modeling Wave Evolution & Currents to Nowcast Surf zone Currents

Seas generated by local winds have been successfully included in the alongshore current model for a section of Huntington Beach, and the model agreement with HB06 current observations are improved. Real-time nowcasts of alongshore currents are continuously available at http://cdip.ucsd.edu/hb06/index.php?xdoc=model. For example, output from this morning (3 April 2008) shows a strong (50 cm/s) northward current that would (if there were a spill) transport pollution from the Santa Anna River toward the heavily used beaches of Huntington Beach. Extension of the surf zone current model to all of Huntington Beach and Santa Monica Bay will begin in the next quarter.

Task B.4 Northern and Central Nearshore Data

Real-time nearshore wave predictions are now available from Pt. Conception to the Golden Gate Bridge on the CDIP website (http://cdip.ucsd.edu/?moplist=Overview&xitem=overmap).

TASK C. ESTABLISH SUBSURFACE OBSERVATIONS

Task C.1 Underway CTD

The underway CTD (uCTD) transects across the San Pedro Channel have been suspended due to US Coast Guard de-certification of the *R/V Sea Watch*, the vessel used for data collection. This situation has been extremely frustrating since the new uCTD purchased as part of this project has performed very well in tests, and all aspects of data collection, archiving, and web-posting were operational. Up until the loss of the *Sea Watch*, this project had proceeded very smoothly. PI Washburn, Mr. Troy Gunderson, and Dr. Rick Pieper, director of the Southern California Marine Institute, are working to find an alternate vessel of opportunity on which to operate the uCTD. Operation of the uCTD depends on ship time being available at no cost to the project. A database of all data collected to date along with various graphs of results is available at:

 http://www.icess.ucsb.edu/iog/uCTD/index.php

Task C.2 Bight-Scale Monitoring

Glider Operations: As planned, we have maintained continuous cross-shelf sampling on CalCOFI Line 90, which runs south southwest from Dana Point. With delays of 6-8 weeks between recovery and the next deployment, we have maintained cross-shelf sampling on CalCOFI Line 67, which runs south southwest from Monterey Bay for another quarter.

Under non-COCMP funding, we have maintained continuous cross-shelf sampling on CalCOFI Line 80, which runs south southwest from Point Conception. All records provide sections to 500 m depth of temperature, salinity, chlorophyll a fluorescence, acoustic backscatter strength at 750 kHz, and absolute velocity sections as measures of variations in physical conditions and the abundance and distribution of phytoplankton and zooplankton. All data is available in real time through the web site spray.ucsd.edu and the SCCOOS web site.

Russ Davis, Mark Ohman, Dan Rudnick, Ben Hodges, and Jeff Sherman are revising their manuscript "Glider surveillance of physics and biology in the southern California Current System" for *Limnology and Oceanography*.

TASK D. ESTABLISH REGIONAL OCEAN MODELING

Task D.1and D.3.2 Model Research and Development and Synthesis of SCCOOS Data and Prediction of Fields

The major activity has been to improve the vertical projector of HF radar data in the vertical direction. This includes developing a more realistic error covariance in the vertical direction, and estimate the optimal balance between the geostrophic and ageostrophic current components.

All other activities are ongoing, with the exception of the ROMS tidal work, for which there has been no activity this quarter.

Task D.2 Wind Product for use by ROM

Tasks under D.2 are ongoing.

Task D.3.1 Covariance and Objective Mapping using COCMP observations

Transition of the improved (weighted least squares) velocity estimation algorithm to the HF radar community continues, as does work on inferring covariances of current directly from the observed radial covariances. CODAR itself has recognized the benefits of the new method.

Terrill and Kim continue to expand the mapping and analysis of the radar observations to the entire west coast, and have been looking at signatures of coastally trapped waves along the coast, as well as eddy statistics and trajectories in the San Diego region. A paper has been submitted on the observed response of the currents to wind, and this has been extended to the entire west coast so that wind-driven effects can be separated from other features.

A paper is in preparation on MITgcm 4DVAR (adjoint) assimilation of radials for the San Diego region on a 1 km grid. The MITgcm 4DVAR assimilation makes adjustments of initial conditions, boundary conditions, and forcing to match the observations in a dynamically consistent model run. The dynamically-consistent hindcast provides a way to diagnose the physical processes important in the coastal region, and the dynamical model provides a complete three-dimensional current field in time with no gaps. The adjustments to the wind are a way of inferring the true wind field from observations of the surface current evolving fields. The comparison of the more stringent 4DVAR assimilation with the JPL 3DVAR should provide insights into the resolving power of our observing network, and the adjoint sensitivity can be used to evaluate observation strategies.

TASK E. DATA DISTRIBUTION AND MANAGEMENT

Task E.1 Information Technology Development

SCCOOS programmers continued HF Radar network development throughout the first quarter of 2008. Programmers implemented memory upgrades and performed database optimization on the data nodes. Memory upgrades will improve processing time, thereby reducing time lags in total vector creation due to hardware limitations. Database optimization is ongoing, and includes effective file size reduction through advanced indexing techniques.

SCCOOS continues its implementation of the COCMP HF radar data exchange for all of California, and has made significant advances in building HF radar data transport for the region. Total vectors are now stored in network common data format (NetCDF). This format enables metadata storage in addition to source data, and will be the primary format used in dissemination. SCCOOS is currently developing data access and services through Open-source

Project for a Network Data Access Protocol (OpeNDAP). This development will continue throughout the next quarter.

SCCOOS and JPL participants met on 10 March to discuss data assimilation into models. JPL operates an HF radar node and assimilates 6km surface current vectors into the Regional Ocean Modeling System (ROMS). JPL is working towards assimilating higher resolution 2km data as well as other *in situ* data. SCCOOS will continue working with JPL in facilitating data transportation and delivery in ingestible formats for the modeling community.

Task E.2 Product Development

A new theme-oriented section targeting harbor-directed activities is currently under development and will be hosted on the SCCOOS website: http://www.sccoos.org/themes/harbors/lalb. This effort merges buoy and model output data from the Coastal Data Information Program with nautical charts, surface currents, and shipping lanes under a single full-page interface designed with feedback from the community to assist shippers, mariners, and harbor officials in the Los Angeles and Long Beach harbor region. This new interface features resizable elements, draggable scales, and clickable, hierarchical data layers. Future improvements to the section will bring additional wind and wave data to users.

SCCOOS programmers continued to support underwater glider data operations by developing a Google maps interface to view Southern California glider missions imported into the SCCOOS data system. This interface adds a missing integrated geospatial perspective to the spray glider data, showing ideal glider tracks, completed missions, and underway missions on the same display along with rapid access to the data from each mission.

SCCOOS transitioned from a non-operational output of the Navy run Coupled Ocean Atmosphere Mesoscale Prediction System (COAMPS) wind model product to an operational output. This transition should allow for a more stable and consistent model online display. Programmers altered ingestion and display to accept the new format. This product is used extensively by the boating community and receives a significant amount of inquiry during outages. SCCOOS programmers anticipate improved data accessibility.

ROMS visualization tools have been released on the SCCOOS website. Users are able to select cross sections of the 3-dimensional model for a detailed view. A value added product, "Virtual Moorings," has also been added for visualizing the water column over time at several fixed locations. These views allow users to compare model data with *in situ* data for model validation. Visualization tools can be found at http://www.sccoos.org/data/roms/ and http://www.sccoos.org/data/roms/virtual/.