Progress Report

Project Title: Sustaining and Expanding the Southern California Coastal Ocean Observing System

Award number: NA21NOS0120088

Period of Activity: 01/01/2022 – 6/30/2022

Principal Investigator: Clarissa Anderson, UCSD - SCCOOS Executive Director

## I. PROJECT MILESTONES:

Milestone Table. Developed and modified from the SCCOOS milestone table available on the cover page of our FY21 and FY22 descope report as well as SCCOOS Goals, Objectives, and Tasks in Table 4 of our FY21-26 proposal. Projects are organized by SCCOOS subsystems and listed in bold. High-level milestones/deliverables are listed below each project. Status of each milestone/deliverable is reported as complete, on-track, or delayed. If the milestone is delayed, a justification for the delay is provided along with a new completion date and description of activities employed or to be employed to mitigate the delay under section II. Progress and Accomplishments.

| **Project and Task(s)** | **Status** |
|---|---|
| GOVERNANCE SUBSYSTEM | |
| **SCCOOS Regional Association Organization & Outreach/Education** | |
| SIO - 1) Maintain a centralized program office that oversees SCCOOS operations and effectively coordinates with all partners to expand capacity 2) Develop regionally relevant, user-driven analysis, decision-support, and visualization products and tools to address historic and emerging stakeholder requirements in the SCCOOS region; 3) Engage stakeholders to gather customer feedback and refine requirements for SCCOOS products and services. 4) Expand and strengthen state, federal, and industry partnerships to innovate ocean observations and information products in collaboration with CeNCOOS. | On-track |
| OBSERVING SUBSYSTEM | |
| **HF Radar Operations & Maintenance** | |
| Sustain & operate 31 High Frequency Radar in the SCCOOS Region - continuous service via HFRNet, SCCOOS, and CeNCOOS | On-track |
| **California Underwater Glider Network (CUGN)** | |

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| SIO - Sustain & operate two Spray glider lines in the SCCOOS region - continuous service with 3-5 month deployments per Spray | On-track |
| **Harmful Algal Bloom (HAB) Monitoring Program + SPATT** | |
| SIO/USC/UCLA/UCSB/CalPoly - Sustain weekly sampling at five pier sites in the SCCOOS region for HAB species, particulate toxins, chlorophyll-a, temperature, salinity, & inorganic nutrients. Harmful plankton taxa abundances, chlorophyll-a, temperature and salinity are reported weekly, and data are submitted weekly to the SCCOOS database. Samples are shipped monthly to USC for domoic acid analysis. Samples are shipped quarterly to UCSB for nutrient analysis. | On-track |
| SIO/USC/UCSB - Sustain weekly SPATT sampling for a suite of dissolved toxins and shipped monthly to USC for analysis. | On-track |
| **SCCOOS Automated Shore Stations (SASS)** | |
| SIO/CSUN/UCSB - Operate & maintain four SCCOOS Automated Shore Stations (SASS) - continuous data service at a 4-min ingestion frequency, with routine (monthly) sensor cleaning and maintenance. Standard station parameters are temperature, salinity, depth, and chlorophyll fluorescence. | On-track |
| **OAH Monitoring on SASS Stations** | |
| SIO - Integrate, operate & maintain self-calibrating SeapHOx (pH and Oxygen sensors) on 3 automated shore stations in the SCCOOS region: Scripps Pier, Santa Monica Pier and Stearns Wharf. Data are provided continuously, with near-real time calibrations applied. Routine instrument cleaning and servicing (e.g. reagent replacement) is coordinated with SASS personnel. | On-track |
| **CalCOFI- Distribution and abundance of marine birds in the Southern California Bight and adjacent waters** | |
| Farallon Inst - Collect seabird & marine mammal distribution and abundance data on winter, spring, and summer CalCOFI cruises and spring/summer NMFS RREAS (rockfish recruitment survey) and deliver annual reports to SCCOOS for incorporation into CCIEA and NMS reports. | On-track |
| **California Multivariate Ocean Climate Indicator (MOCI)** | |
| Farallon Inst - Update and disseminate the Multivariate Ocean Climate Indicator (MOCI) - CeNCOOS collaboration- for incorporation into customized data synthesis products and curated data views | On-track |
| **Statewide Kelp Canopy Area/Biomass Dynamics** | |
| WHOI - Incorporate kelp biomass database into our portal & develop user-driven | On-track |

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| discovery tools & displays - CeNCOOS collaboration - for incorporation into customized data synthesis products, curated data views, and made available for all relevant assessments, e.g. MPAs | |
| **California Coastal Flood Network** | |
| SIO - Support & expand the California Coastal Flood Network, adding a new Southern California site to the threshold validation/evaluation process each year | On-track |
| **HABON Pilot - CA IFCB Network O&M** | |
| Operate and maintain a network of twelve Imaging FlowCytobots (IFCBs) to identify HAB species in real-time at critical land-based *and* offshore locations throughout California. | On-track |
| **CDIP - Long Beach Wave Buoy Model Validation** | |
| Operate and maintain the Long Beach wave buoy and model validation in support of marine operations/navigation at the Port of Long Beach. | On-track |
| **DATA MANAGEMENT AND COMMUNICATION SUBSYSTEM** | |
| **SCCOOS DMAC** | |
| SIO - 1) Support ongoing maintenance, operation, and development of SCCOOS cyberinfrastructure to sustain long-term data stewardship for our partners and stakeholders; 2) Promote data standardization, automation, discovery, and public access; 3) Strengthen data stewardship within the SCCOOS consortium to improve data quality, access, attribution, exchange, delivery, and storage and; 4) Support the functionality of national data assembly centers through leadership in observation and product delivery, quality control methods, and capacity building. | On-track |
| **Axiom Data Science** | |
| ADS - 1) Enable and support SCCOOS Cyberinfrastructure and development of a new Statewide Data Portal; 2) Ingest and maintain SCCOOS-operated and Non-SCCOOS Data Assets, including sensors, Gliders, HF Radar, models, biological, and historical legacy time series; 3) Implement real-time sensor data quality control system and; 4) Support the creation of data-driven products and applications. | On-track |
| **CalCOFI - Data Synthesis and Serving/Product Development** | |
| SIO - Data synthesis & product development in support of CalCOFI, fisheries, & National Marine Sanctuaries; continual syntheses and automated, curated data views will be developed and vetted with crucial stakeholder partners | On-track |

| MODELING AND ANALYSIS SUBSYSTEM | |
|---|---|
| **ROMS - 3 km Statewide Operational model** | |
| Seatrec - Support & serve real-time, data-assimilative ROMS predictions to SCCOOS & CeNCOOS end-users; models are run on SCCOOS servers and output is provided hourly to daily to the SCCOOS portal. This operation will be terminated by October 31, 2022 and replaced by the WCOFS run at NOAA. | On track |
| **ROMS - High Resolution Shelf and Nearshore Physics** | |
| UCLA - Support nearshore ROMS development for improved physics of direct relevance to water quality managers and SCCOOS partners; SCCOOS supports a project page with annual updates of model output/visualizations of nearshore physics developments | On track |

## II. PROGRESS AND ACCOMPLISHMENTS

| High-Frequency Radar | | |
|---|---|---|
| **Amount** | **Funding Area** | **Task** |
| $1,085,000 | Core | Status:<br>The Southern California High Frequency Radar Network (HFRNet), a backbone of the Integrated Ocean Observing System (IOOS), supports both operational and research communities by providing high quality, spatially dense, ocean surface current data in near real-time. These economical and effective remote sensing instruments map coastal ocean surface currents to assess both regional- and local -scale physical changes in the coastal oceans.<br>The 31 SCCOOS individual radar stations, regionally operated, report data to nodes for subsequent processing, quality control, display, backup, and distribution to operational users including the U.S. Coast Guard, NOAA's National Data Buoy Center and Office of Restoration and Response. SCCOOS participates in biweekly technical calls with CA operators and has hosted informational meetings with stakeholders, as detailed in the accomplishments below.<br><br>Accomplishments:<br><br>Issue (if any): The network is in need of recapitalization. Approximately 15% of the CA High Frequency Radar Network has exceeded the normal service life of the equipment of 20 years and |

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| | | 96% of the network has reached the half-way point of its service life of 10 years. Recapitalization would also allow for spare components for when sites go down, which necessitates a lengthy repair from CODAR and long downtimes of certain sites if no backups of certain components (e.g., combined TX/RX antenna). |

| Names of existing and planned HFR stations | Status | Date of most recent antenna calibration | Date planned for next antenna calibration | Recapitalization needs |
|---|---|---|---|---|
| AGL1 | Operational. Replaced GPS antenna. Installed new computer and hard drives with R21 software. Data backed up on new physical server that was recently replaced. | 9/15/2021 | 9/2022 | TX chassis, RX chassis, TX antenna |
| ARG1 | Operational. Installed new TRIA on satellite dish and realigned. Installed new computer and hard drives with R21 software. Data backed up on new physical server that was recently replaced.. | 9/15/2021 | 9/2022 | RX chassis, TX chassis |
| PTC1 | Operational. UPS backup battery died and was replaced. Combined RX/TX antenna failed and awaiting repair from CODAR. Data backed up on new physical server that was recently replaced. | 11/18/2021 | 11/2022 | RX chassis, TX chassis |
| FBK1 | Operational. Replaced GPS antenna. Data backed up on new physical server that was recently replaced . | 9/27/2021 | 9/2022 | RX chassis |
| LUIS | Operational. GFI on outlet was replaced after multiple failures and eventually removed and bypassed due to continued failures. Installed new GPS antenna and AWG after failures. Replaced computer and installed R21 software. Data backed up on new physical server that was recently replaced | 10/21/2021 | 10/2022 | RX chassis, TX chassis |

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|---|---|---|---|---|
| SDPL | Station continues to operate nominally. | 09/29/2020 | 10/2022 | New HPWREN link antennas and power infrastructure |
| SDBP | Operating nominally. 4G connectivity was improved and a new calibration was installed. | 06/06/2022 | 06/2023 | |
| SDSE | We had some downtime due to the Rx unit failing. The chassis was replaced and a new calibration was installed. | 06/06/2022 | 06/2023 | RMA old chassis |
| SDSC | We had some downtime due to the AC unit going bad and access to the island being limited. Site is now operational and has been retrofitted with a new AC unit, new computer, CODAR R21 software and an AIS receiver for autoAPM calibrations. | 4/27/2021 | 08/2022 | Rx Chassis<br>Tx Chassis<br>Rx Antenna<br>Tx Antenna |
| SDCP | Station continues to operate nominally. An AIS receiver and adding autoAPM capabilities are planned for this site since we can't do walking or UAS calibration. | Ideal Pattern | Unknown | Install AIS receiver and upgrade software to include autoAPM. |
| SDUT | Site is operational but suspected to have a GPS module failure. Antenna cable was placed in conduit. | 06/07/2022 | 06/2023 | Rx Chassis<br>Rx Antenna |
| SDDP | Site operating nominally. The box-style antenna is starting to show signs of signal degradation and should be upgraded soon. | 6/27/2019 | 06/2023 | Rx antenna |
| SDWW | The site operating nominally and was retrofitted with a new computer. | 6/4/2020 | 01/2022 | Tx Chassis<br>Rx Chassis |
| SDCI | Site has been not operational due to access becoming increasingly difficult. We're still trying to make some headway with collaborators down in Mexico. | 10/18/2018 | Unknown | Batteries for solar system<br>Rx antenna<br>New HPWREN link antennas |
| SDSL | Site operating nominally. A new | 6/08/2020 | 06/2023 | Rx Chassis |

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| | calibration was installed. | | | Tx Antenna |
| SDSN | Site operating nominally. The site was also retrofitted with a new computer running CODAR software R21, an AIS receiver and autoAPM capabilities. | 03/20/2021 | 04/2022 | |
| RFG1 | RFG1 has been operational over the reporting period. There have been occasional short-term outages due to power shut-offs by Southern California Edison, TX antenna was re tuned for optima power output | 02/01/2022 | 02/2023 | Rx Chassis<br>Tx Antenna<br>New AC |
| TRL1 | TRL1 is not currently operational as a mobile site. The main component of TRL1 is a trailer with an integrated solar power system. A new solar trailer has been ordered and is expected to be delivered sometime in August, 2022. | N/A | N/A | |
| SCI1 | SCI1 has been operating fairly consistently during the reporting period. There was a 2 month gap in data due to a bad TX antenna and RX chassis. | 12/01/2021 | 12/2022 | Rx Chassis<br>Tx Antenna<br>New A/C |
| SNI1 | SNI1 has had outages due to failure of island-supplied power. Eduardo Romero visited the site to correct hardware issues and assess the status of the trailer used to house HFR equipment. We are in the process of purchasing a new trailer for the site. | Not possible due to military regulations. APMs done via ships of opportunity. | Not Possible due to military regulations . APMs done via ships of opportunity . | Rx Chassis<br>Tx Antenna<br>New Trailer Enclosure<br>New AC<br>AIS antenna pattern hardware/license |
| COP1 | COP1 has been operational over the reporting period. | 08/25/2021 | 08/2022 | Rx Chassis<br>Tx Antenna |
| PTM1 | PTM1 has been operational over the reporting period. | 11/09/2021 | 11/2022 | Rx Chassis<br>Tx Antenna |

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|---|---|---|---|---|
| SSD1 | SSD1 has been operational over the reporting period. | 08/06/2021 | 08/2022 | New A/C |
| MGS1 | MGS1 has been operating fairly consistently during the reporting period. During this reporting period the UCSB HFR group met virtually with the new property owner to discuss access to the site. The owner was very cooperative and we will have access until the owner reconfigures the site for business purposes. | 03/23/2022 | 02/2023 | Rx Chassis<br>Tx Antenna<br>New AC |
| NIC1 | NIC1 has been operational over the reporting period. Operation has been satisfactory. | 02/01/2022 | 02/2023 | New Front Door for enclosure |
| SCCI | Operational: Auto APM software installed. | Auto APM installed 4/15/22 | n/a | |
| SCDH | Non-Operational: The site has been non-operational since mid-February. After diagnosing and confirmation with CODAR, it was determined a 24v power supply had failed. Replacement is challenging to do supply chain issues. | n/a | Third quarter 2022 | Electronics enclosure ($5,000) |
| SCTB | Operational: The site was reinstalled in July. A new antenna has been delivered and will be installed in the Third Quarter. | 11/18/2021 | 11/2022 | |
| SCPF | Operational: The site has been operating satisfactorily throughout this project period. | 02/28/2018 | Third quarter 2022 | New Tx chassis ($36,750)<br>New Rx chassis ($68,250) |
| SCNB | Operational: The new electronics chassis were installed. There is a damaged radial antenna and plans are being made to repair the antenna. | 10/24/2021 | 10/2022 | New antenna ($23,000)<br>New cables ($1,800)<br>New electronics enclosure ($5,000) |
| SCDB | Operational: The site has been operating satisfactorily during the | 11/23/2021 | 11/2022 | New antenna ($23,000) |

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| | project period. | | | |

Additionally, if your RA operates HFR data servers or other information technology (IT) computing infrastructure for HFR beyond the stations themselves, please include a narrative for each such component in the table below (adding rows as needed).

| **Names of RA's HFR IT Systems** | **Status** | **Recapitalization needs** |
|---|---|---|
| SIO Portal | Operational | N/A - planned in HFRNet |
| UCSB Portal | Operational - The portal is hosted as a virtual machine that is in the processing of being migrated to a new hardware cluster. | N/A - planned in HFRNet |
| Rutgers Portal | Operational | N/A - planned in HFRNet |
| USM Portal | Operational | N/A - planned in HFRNet |
| MBARI Portal | Operational | N/A - planned in HFRNet |
| UMiami Portal | Operational | N/A - planned in HFRNet |
| OSU Portal | Operational | N/A - planned in HFRNet |

## Gliders and Other Uncrewed Systems (UxS)

**Summary of glider activities over the reporting period: Line 80 and alongshore**

| **Mission** | **Serial No.** | **Deploy Date** | **Recover Date** | **Days** | **Distance (km)** | **Dives** |
|---|---|---|---|---|---|---|
| 21A06401 | 64 | 28-Oct-2021 | 16-Feb-2022 | 111 | 2370 | 1007 |
| 22204001 | 40 | 17-Feb-2022 | 31-Mar-2022 | 42 | 1010 | 425 |
| 0058 active | 58 | 31-Mar-2022 | Ongoing | 109 | 2202 | 903 |
| 21B01301 | 13 | 30-Nov-2021 | 02-Mar-2022 | 92 | 2045 | 822 |
| 22105501 | 55 | 19-Jan-2022 | 13-May-2022 | 114 | 2807 | 1075 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 0013 active | 13 | 13-May-2022 | Ongoing | 66 | 1331 | 544 |

**Accomplishments / successes:** All operations are on track. One publication during the report period.

**Problems/delays:** None

**Other UxS activities of note (status/accomplishments, etc.):**

| Other Core Observation Activities |
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## SCCOOS Automated shore stations (SASS)

***PIs: Anderson/Carter (SIO), Nickols (CSUN), Washburn (UCSB)***

**Summary of other Observation Activities over the reporting period:**

- The Stearns Wharf automated shore station has been in constant operation over the reporting period. SCUBA diving teams teams led by David Salazar and Eduardo Romero (UCSB) have performed monthly maintenance operations on the station, such as instrument cleaning and assessment. Salazar has worked with Melissa Carter at SIO on maintenance issues related to the site.
- The Santa Monica Pier automated shore station has been in constant operation over the reporting period. SCUBA diving teams led by Kerry Nickols (CSUN) have performed monthly maintenance operations on the station, including instrument cleaning and assessment, and collection of calibration samples for salinity. Nickols has worked with Melissa Carter (UCSD) on maintenance issues related to the site, including an extra trip by Carter and Martin in March to replace the CTD power cable and pump.
- The Newport Beach Pier (NBP) automated shore station has been in constant operation over the reporting period except for 1 month when construction to the pier pilings at NBP required full removal of sensors (4-May 2022 to 8-June 2022). SCUBA diving teams led by Melissa Carter (UCSD) have performed monthly maintenance, including sensor cleaning and collection of calibration samples for salinity, pH and oxygen at this station.
- The Scripps Pier automated shore station has been in constant operation over the reporting period, except from 30-March to 8-April, 2022 when the power data cable from CTD to topside failed and was replaced. SCUBA diving teams led by Melissa Carter (UCSD) have performed monthly maintenance, including sensor cleaning and collection of calibration samples for salinity at this station.

**Accomplishments / successes:**

- David Salazar and Eduardo Romero assisted Nathalie Guillocheau (UCSB) with the installation of the IFCB at the Stearns Wharf shore station. They built a protective housing for the electronics equipment and installed a peristaltic pump and tubing to lift seawater for the IFCB sampling. Some focus and syringe-related issues were overcome, and the IFCB has been operating pretty consistently so far.

- Underwater deployment of the IFCB at the Newport Beach Pier station was in collaboration with SASS efforts by Melissa Carter and Kayla Martin (UCSD).
- The Newport Beach station has continued collection of pH measurements since deployment of the SeaBird SeaFET on 17 December 2020 and has continued oxygen measurements since Oct 2016. Carter and Martin worked extensively with SCCOOS data management to provide real-time access to these new parameters, available since January 2022. Additional funding for these sensors and maintenance has been provided by Orange County Sanitation District.
- Carter and Martin worked extensively with SCCOOS data management to incorporate fluorometer calibration coefficients in real-time data displays and in updated calculations of chlorophyll concentration (2013 to present) when WetStar fluorometers were installed at all SASS stations, available since January 2022.

**Problems/delays:**

- Biofouling of the fluorometer continues to be an ongoing issue at all shore station sites. This problem was exacerbated by strong winds and upwelling in the region through spring. At Stearns Wharf, a test of our latest experimental anti-biofouling approach ended prematurely due to maintenance operations of the pumping system that feeds seawater to the Sea Center located on Stearns Wharf. Recently we have been considering moving the fluorometer to the surface and pumping excess water from the IFCB input through the fluorometer. This would greatly facilitate cleaning of the fluorometer.
- The SASS network is in need of recapitalization. All four stations have exceeded 10 years of use of critical underwater infrastructure including pier clamps and conduit, and all stations have original underwater protective cages lasting almost 20 years. In addition, the current WetStar SASS fluorometer is being discontinued and new fluorometers, cables and supporting hardware will need to be purchased and installed to continue these measurements once sensors fail. Recapitalization would also provide for spare components such as backup sensors, pumps, underwater power-data cables, sensor cables, and critical network hardware. Replacement of aging components and having spares on hand can reduce downtimes and continue real-time ocean observations.

| Station | Parameters | Date of Most Recent Deployment | Recapitalization Needs |
|---|---|---|---|
| Scripps Pier | Temperature<br>Chlorophyll<br>Salinity<br>Depth<br>pH<br>Oxygen<br>IFCB | CTD Package: 9/15/21<br>Self-calibrating SeapHOx: 4/8/2022 | Pier Clamp, Power-Data Conduit Replacement (need in 2023)<br>New Fluorometer- (ASAP -Seabird discontinued current fluorometer)<br>CTD Cable x 2 (Backups for other stations - 2023) |
| Newport Beach Pier | Temperature<br>Chlorophyll<br>Salinity<br>Depth<br>pH<br>Oxygen<br>IFCB | CTD Package: 9/09/22<br>SeaFET: 6/9/2022<br>IFCB: 7/7/2022 | Pier Clamp, Power-Data Conduit Replacement (need ASAP) New Fluorometer (ASAP -Seabird discontinued current fluorometer) |
| Santa Monica Pier | Temperature<br>Chlorophyll<br>Salinity<br>Depth | CTD Package: 3/10/2022 | Pier Clamp, Power-Data Conduit Replacement (need in 2023)<br>New Fluorometer-ASAP (Seabird discontinued current fluorometer) |
| Stearns Wharf | Temperature<br>Chlorophyll<br>Salinity<br>Depth<br>IFCB | CTD Package: 2/25/2022<br>IFCB: 4/15/2022 | Pier Clamp, Power-Data Conduit Replacement (need in 2023)<br>New Fluorometer-ASAP<br>Pier Clamp (2023)<br>CTD Cable |

### OAH Monitoring on SASS Stations

***PI: Martz (SIO)***

**Accomplishments / successes:** Two successful Self-Calibrating SeapHOx (SCS) deployments at the Scripps Pier in collaboration with SIO SASS efforts. SCS has been operating continuously since Feb 2022, generating data and autonomous calibration points. Data are being provided in real-time to Axiom Data Science for integration into the SCCOOS pipeline.

**Problems/delays:** The first deployments have encountered two problems. On deployment #2, the self-calibrating mechanism stopped working, indicating either a faulty valve or empty bag. Sensor data remain normal and real-time diagnostic engineering data suggest that the valve continues to work, indicating a problem with the buffer bag or line connecting bag to valve. The sensor will be recovered in Aug or Sep for inspection. Another issue that has been noted is the orientation of the re-engineered sensor package seems to promote sediment accumulation on the

oxygen sensor. In order to address this issue, it may be necessary to mount the SCS in a 180-degree rotated (upside-down) position. This has been done by other groups and we anticipate no major challenge in changing the mounting orientation.

### Harmful Algal Bloom Monitoring Alert Program

***PIs: Anderson/Carter (SIO), Shipe (UCLA), Caron (USC), Brzezinski (UCSB), Pasulka (Cal Poly)***

**Accomplishments / successes:**
Timely information on HAB events at the 5 sample sites is uploaded to the SCCOOS website and data server on a weekly basis, as well as distributed to local, state, and federal partners in weekly reports to the CA HABMAP (California Harmful Algae Monitoring and Alert Program) listserv. Particulate domoic acid sample analysis is performed monhtly on the weekly filtered water samples, monthly to quarterly dissolved toxin analysis from SPATT (both performed at USC) on bi-weekl samples, and quarterly nutrient analyses (UCSB) on weekly samples to address stakeholder needs and feed into the monthly CA HAB Bulletin summaries of HABs and HAB predictions state estimates from the previous month.
**Problems/delays:** None

### Multivariate Ocean Climate Indicator (MOCI)

***PI: Garcia-Reyes (FI)***

**Summary of other Observation Activities over the reporting period:** MOCI updated as scheduled.
**Accomplishments / successes:**

- MOCI Updated for fall 2021 and winter 2022 quarters.
- Scripts and input data have been revised and updated.

**Problems/delays:** None.

### Seabird and Marine Mammal Observations

***PI: Sydeman (FI)***

**Summary of other Observation Activities over the reporting period:** Surveys conducted in winter, spring CalCOFI, and spring RREAS, but see issues below.
**Accomplishment / successes:** Data collection successful, on track; data reports produced and shared online on schedule.
**Problems/delays:** RREAS was delayed by 2 weeks, then aborted due to shipboard COVID outbreak. Nonetheless about 20 days of data was collected by the end of the survey period.

### Statewide Kelp Canopy Area/Biomass Dynamics

***PI: Bell (WHOI)***

**Summary of other Observation Activities over the reporting period:** Kelp canopy products (biomass/area) were derived for Q4 2021 and Q1 2022 and delivered to the data portal during this six month period.
**Accomplishments / successes:** I have integrated new Landsat 9 imagery into the dataset that replaced Landsat 7 (now decommissioned).
**Problems/delays:** None.

### California Coastal Flood Network
***PI: Merrifield (SIO)***

**Summary of other Observation Activities over the reporting period:** Added the IPA-based Malibu flood forecast and associated historical beach slopes to the weblink.
**Accomplishments / successes:** Flood alerts are now derived with ECMWF-driven MOP forecasts, improving obvious underpredictions. Completed installation of citizen-science CoastSnap cradles at 2 locations for outreach and future validation studies.
**Problems/delays:** None.

### DMAC Activities
***PI: Anderson (SIO), Bochenek (ADS)***

**Summary of other Observation Activities over the reporting period:** We continue to ingest, maintain, and serve SCCOOS and non-SCCOOS data assets for discovery and access in the CalOOS data portal.
**Accomplishments / successes:** Developed and released new California Ocean Observing Systems Data Portal (data.caloos.org). Developed a new service to calibrate chlorophyll, O2, and pH data that are being collected by SCCOOS Shore Stations (data are being displayed through a new SCCOOS Automated Shore Stations dashboard); added six new IFCB data streams; updated a new CalHABMAP dashboard to display phytoplankton abundance, domoic acid and nutrients including ammonium, nitrate, phosphate, and silicic acid monitoring data. These data are synthesized and translated for the public by SCCOOS (Anderson, Medina, and Timmerman) in the monthly CA HAB Bulletin. We also ingested various datasets including West Coast Operational Forecast System nowcast layers; C-HARM model nowcast and forecast surface layer; U.S. Navy meteorological stations; bird, fish, and crab pot observations; and the Multivariate Ocean Climate Indicator (MOCI). Axiom Data Science also participated in various regional, state, and national DMAC activities, including regular weekly calls and regional meetings in support of SCCOOS DMAC.
**Problems/delays:** None

### CalCOFI - Data Synthesis and Serving/Product Development
***PI: Semmens (SIO)***

**Summary of other Observation Activities over the reporting period:** We continue to create ocean observing data synthesis and serving tools that serve the needs of the California public and ocean ecosystem management organizations along the US West coast. We have been working on the development of both back-end (i.e., data curation, QA/QC, and preparation) and front-end infographic components. The front end graphics will highlight ecosystem and/or region-specific trends and status reports and we will work with SCCOOS in the coming year to integrate SCCOOS andCeNCOOS data (in collaboration with the TBD Product Developer at SCCOOS) into the infographic and curated data displays.
**Accomplishments / successes:** We have developed the PostGres SQL database including larval fish and hydrographic data. In addition, we have developed an R package and API (https://api.calcofi.io/__docs__/) to ingest and submit data. We also have completed a concept/prototype of the front end interactive data application. Current progress can be viewed at https://calcofi.io/.
**Problems/delays:** None

### ROMS High Resolution Shelf and Nearshore Physics

***PI: McWilliams (UCLA)***

**Summary of other Observation Activities over the reporting period:** We continue to configure nested model domains with surface wave coupling to the circulation and material transport. The present focus is on nearshore currents in the Santa Barbara region.
**Accomplishments / successes:** A new paper on interaction of submesoscale fronts and Langmuir circulations was submitted to JPO (Hypolite et al., 2022), another was submitted to JGR on interaction of internal tidal bores with nearshore fronts (Dauhajre et al., 2022), and yet another was submitted to JPO on surface wave effects on coastal upwelling (Wang et al., 2022).
**Problems/delays:** None.

| IOOS, NOAA, Other Agency Funding (non-core funding) | | |
|---|---|---|
| **Funding amount spent** | **Funding Area /Recipient** | **Task: please provide a status update.** |
| Provided $10,000<br>Spent $9,941.45<br>Remaining $58.55 | CDIP - Long Beach Buoy Wave Buy Model Validation | Status: on-track<br>Accomplishment: These funds support the maintenance of CDIP Long Beach Wave Buoy<br>Issue (if any): UCSD did not release the funds until October 2021. |
| Provided $137,500 Spent $27,773.94 Remaining $109,726.06 | HABON Pilot - CA IFCB Network O&M | Status: on-track<br>Accomplishments:<br>● IFCB deployed at Stearns Wharf<br>● April 28, 2022: CA IFCB Network update call, virtual<br>● May 9-13, 2022: Global HAB Modeling Workshop, Glasgow, Scotland- C. Anderson co-chair<br>● May 14, 2022: CA IFCB and HAB DAC update at GlobalHAB Scientific Steering Committee meeting, Glasgow, Scotland<br>● Classifier application at all SoCal sites and management engagement for product development (leverages OPC and PCMHAB project)<br>Issue (if any): UCSD did not release the funds until October 2021. |

**III. PROJECT CHALLENGES/MODIFICATIONS RELATED TO COVID (200 words):**

- RREAS was delayed by 2 weeks, then aborted due to shipboard COVID outbreak. Nonetheless, about 20 days of data were collected by the end of the survey period.
- Four invited speakers were unable to present in person at the CalOOS Science Impact and Stakeholder Meeting in May due to testing positive to COVID or known immediate exposure.

## IV. PUBLICATIONS AND REPORTS:

1. Alexandri, T., & Diamant, R. (2022). Design of an Optimal Testbed for Tracking of Tagged Marine Megafauna. *Marine Megafauna*. https://doi.org/10.3389/fmars.2022.854002 - **References NGDC Bathymetry data downloaded from SCCOOS**
2. Aron, J., Albert, P. S., & Gribble, M. O. (2022). Modeling Dinophysis in Western Andalucía using a autoregressive hidden Markov model. Environmental and Ecological Statistics, 1-29. https://doi.org/10.1007/s10651-022-00534-7 - **Acknowledges Clarissa Anderson for advising on HAB modeling**
3. **Bell, T.W.**, Siegel, D.A. (2022), Nutrient availability and senescence spatially structure the dynamics of a foundation species, *Proceedings of the National Academy of Sciences, 119, 1, e2105135118*. https://doi.org/10.1073/pnas.2105135118. **- References SCCOOS Kelp Canopy Data; SCCOOS PI Tom Bell**
4. Bresnahan, P., Cyronak, T., Brewin, R. J., Andersson, A., Wirth, T., **Martz, T.**, ... & Waters, S. (2022). A high-tech, low-cost, Internet of Things surfboard fin for coastal citizen science, outreach, and education. *Continental Shelf Research*, 104748. https://doi.org/10.1016/j.csr.2022.104748 - **References SCCOOOS Automated Shore Station data at Scripps Pier; SCCOOS PI Todd Martz**
5. Castorani, M.C.N., **Bell, T.W.**, Walter, J.A., Reuman, D.C., Cavanaugh, K.C., Sheppard, L.W. (in press), Disturbance and nutrients synchronize kelp forests across scales through interacting Moran effects, Ecology Letters. https://doi.org/10.1111/ele.14066. **- References SCCOOS Kelp Canopy Data, SCCOOS PI Tom Bell**
6. Dauhajre et al., 2022 JGR - in review; **SCCOOS PI Jim McWilliams**
7. Emery, B., Kirincich, A., & **Washburn, L.** (2022). Direction Finding and Likelihood Ratio Detection for Oceanographic HF Radars. *Journal of Atmospheric and Oceanic Technology*, *39*(2), 223-235. https://doi.org/10.1175/JTECH-D-21-0110.1 **- References SCCOOS high-frequency radar data; SCCOOS PI Libe Washburn**
8. Free, C. M., Moore, S. K., & Trainer, V. L. (2022). The value of monitoring in efficiently and adaptively managing biotoxin contamination in marine fisheries. *Harmful Algae*, 114, 102226. https://doi.org/10.1016/j.hal.2022.102226 **References SCCOOS Harmful Algal Bloom Monitoring Alert Program Data**
9. Frieder, C., Yan, C., Chamecki, M., Dauhajre, D., **McWilliams, J. C.**, Infante, J., ... & Davis, K. (2022). A macroalgal cultivation modeling system (MACMODS): Evaluating the role of physical-biological coupling on nutrients and farm yield. *Frontiers in Marine Science*, 214. https://doi.org/10.3389/fmars.2022.752951 - **SCCOOS PI Jim McWilliams**
10. Gallo, N. D., Bowlin, N. M., Thompson, A. R., Satterthwaite, E. V., Brady, B., & **Semmens, B. X.** (2022). Fisheries Surveys Are Essential Ocean Observing Programs in a

Time of Global Change: A Synthesis of Oceanographic and Ecological Data From US West Coast Fisheries Surveys. *Frontiers in Marine Science*. https://doi.org/10.3389/fmars.2022.757124 - **References SCCOOS; SCCOOS PI Brice Semmens**

11. **García-Reyes, M.**, Thompson, S. A., Rogers-Bennett, L., & **Sydeman, W. J.** (2022). Winter oceanographic conditions predict summer bull kelp canopy cover in northern California. *PloS one*, *17*(5), e0267737. https://doi.org/10.1371/journal.pone.0267737 **SCCOOS PI Marisol Garcia-Reyes and Bill Sydeman**
12. Grigoratou, M., Montes, E., Richardson, A.J., Everett, J.D., Acevedo-Trejos, E., **Anderson, C.**, Chen, B., Guy-Haim, T., Hinners, J., Lindemann, C., Garcia, T.M., Möller, K.O., Monteiro, F.M., Neeley, A.R., O'Brien, T.D., Palacz, A.P., Poulton, A.J., Prowe, A.E.F., Rodríguez-Santiago, Á.E., Rousseaux, C.S., Runge, J., Saad, J.F., Santi, I., Stern, R., Soccodato, A., Våge, S., Vogt, M., Zervoudaki, S. and Muller-Karger, F.E. (2022), The Marine Biodiversity Observation Network Plankton Workshops: Plankton Ecosystem Function, Biodiversity, and Forecasting—Research Requirements and Applications. *Limnology and Oceanography Bulletin*. https://doi.org/10.1002/lob.10479 - **SCCOOS PI Clarissa Anderson**
13. Hypolite et al. (2022) *Journal of Physical Oceanography* - in review; - **SCCOOS PI Jim McWilliams**
14. Howard, M. D., Smith, J., **Caron, D.A.**, Kudela, R.M., Loftin, K., Hayashi, K., ... & Theroux, S. (2022). Integrative Monitoring Strategy for Marine and Freshwater Harmful Algal Blooms and Toxins Across the Freshwater-to-Marine Continuum. *Integrated Environmental Assessment and Management*. https://doi.org/10.1002/ieam.4651 **SCCOOS PI David Caron, USC**
15. Jaffe, J. S., Le, K. T., Yuan, Z., Syed, A., Ratelle, D., Orenstein, E., **Carter, M.L.** ... & Vasconcelos, N (2022). Benchmarking and Automating the Image Recognition Capability of an In situ Plankton Imaging System. *Frontiers in Marine Science*, 655. https://doi.org/10.3389/fmars.2022.869088 - **References SCCOOS HABMAP data; SCCOOS PI Melissa Carter**
16. Kenkel C.D., Smith J., Hubbard K.A. , Chadwick C., Lorenzen N., Tatters A.O. and **Caron D.A.** Tentative acceptance. Reduced representation sequencing accurately quantifies relative abundance and reveals population-level variation in *Pseudo-nitzschia* spp. *Harmful Algae.* - **Employs cultures established, in part, from samples collected at a part of the SCCOOS HAB program; SCCOOS PI David Caron**
17. Ollison, G.**,** J. Hopper, S. Hu, B. Stewart, J. Smith, Jayme, J. Beatty, L. Rink and **D.A. Caron**. In press. Daily Dynamics of Contrasting Spring Algal Blooms in Santa Monica Bay (central Southern California Bight). *Environmental Microbiology* **- References SCCOOS HAB data collected at Santa Monica pier.**
18. Orenstein, E. C., Saberski, E., & Briseño-Avena, C. (2022). Discovery and dynamics of a cryptic marine copepod-parasite interaction. *Marine Ecology Progress Series*, 691, 29-40.

https://doi.org/10.3354/meps14072. **- Reference SCCOOS HABMAP data at Scripps Pier**

19. Ren, A. S. and **D.L. Rudnick**, 2022: Across-shore propagation of subthermocline eddies in the California Current System. *Journal of Physical Oceanography*, **52,** 39-51, https://doi.org/10.1175/JPO-D-21-0137.1. - **SCCOOS PI Daniel Rudnick**
20. Ruhl HA, **Anderson CR**, Edwards CA, Low NHN, **La Valle FF**, LaScala-Gruenewald DL, Drake PT, Bochenek R, Kahru M, Daniel P, and Jocox MG. Integrated ocean observing systems for assessing marine protected areas across California. California Department of Fish and Wildlife Report. **SCCOOS PI Clarissa Anderson and Post-doc Flo La Valle**
21. Shangguan, Q., Prody, A., Wirth, T. S., Briggs, E. M., **Martz, T. R.**, & DeGrandpre, M. D. (2022). An inter-comparison of autonomous in situ instruments for ocean CO2 measurements under laboratory-controlled conditions. *Marine Chemistry*, *240*, 104085. https://doi.org/10.1016/j.marchem.2022.104085 **- SCCOOS PI Todd Martz, UCSD**
22. Shipley, K. (2022). Biogeochemical Observations in a Southern California Lagoon. Dissertation, University of California San Diego. **- References SCCOOS pH and O2 data; SCCOOS PI Todd Martz lead Advisor**
23. Steele, T. S., Brunson, J. K., Maeno, Y., Terada, R., Allen, A. E., Yotsu-Yamashita, M., ... & Moore, B. S. (2022). Domoic acid biosynthesis in the red alga Chondria armata suggests a complex evolutionary history for toxin production. *Proceedings of the National Academy of Sciences*, *119*(6), e2117407119. DOI: https://doi.org/10.1073/pnas.2117407119 **- Many SCCOOS ECOHAB team members**
24. Southern California Health & Air Quality: Using Remote Sensing to Detect the Frequency and Drivers of Red Tide Blooms in California to Assist in the Management of Human and Marine Exposure to Algal Toxins. NASA DEVELOP National Program California – Ames - **C. Anderson Student Advisor**
25. U.S. Environmental Protection Agency Region 9. Endangered Species Act (ESA) Section 7(a)(2) Biological Opinion and Magnuson–Stevens Fishery Conservation and Management Act Essential Fish Habitat Response. **- References SCCOOS HAB**
26. Walter, J.A., Castorani, M.C.N., **Bell, T.W.**, Sheppard, L.W., Cavanaugh, K.C., Reuman, D.C. (2022), Tail-dependent spatial synchrony arises from nonlinear driver-response relationships, *Ecology Letters, 25, 1189-1201*. https://doi.org/10.1111/ele.13991 **- References SCCOOS Kelp Canopy Data, SCCOOS PI Bell**
27. Wang et al. 2022 *Journal of Physical Oceanography.* - in review; **SCCOOS PI Jim McWilliams**
28. Yan, C., **McWilliams, J. C.**, & Chamecki, M. (2022). Overlapping boundary layers in coastal oceans. *Journal of Physical Oceanography*, *52*(4), 627-646. https://doi.org/10.1175/JPO-D-21-0067.1 **- SCCOOS PI Jim McWilliams**

## V. EDUCATION, MEDIA ENGAGEMENT, AND OUTREACH MATERIALS:

A. Notable Presentations, Posters, Exhibits, Tour and outreach efforts:
*Presentations were virtual unless otherwise specified

- February 2, 2022: LA/LB Harbor Safety Meeting
- February 4, 2022: Ocean Sciences, OC24 Climate Session #2 - C. Anderson Chaired the Session
- February 4, 2022: Ocean Sciences, OC24 Climate Session #3 - C. Anderson Chaired the Session
- February 4, 2022: Ocean Sciences Presentation - Pasulka, A.L., Walter, R., Barth, A., Gilbert, J., Robbins, I. Phytoplankton phenological shifts as indicators of oceanographic change in Central California.
- February 4, 2022: Ocean Sciences Presentation - Abraham, J., Walter, R.K, Huie, S.A., , Pasulka, A.L, Davis, K. Seasonal controls on nearshore hypoxia in an upwelling bay.
- February 4, 2022: Ocean Sciences Presentation - Carter, M.L, Ternon, E., Wilson, J., Cancelada, L., Anderson, C., Prather, K., Bowman, J., Gerwick, W.H. Yessotoxin production and aerosolization during the unprecedented red tide of 2020 in southern California. - M. Carter Presented
- February 8, 2022: SIO242B Marine Biotechnology Lecture - C. Anderson presented
- February 9-10, 2022: RESON NSF CoPe Workshop #2 - C. Anderson Presented
- February 18, 2022: USCG Commandant Adm Karl Schultz Visit - C. Anderson presented
- February 22, 2022: CeNCOOS Governing Council Meeting - C. Anderson presented
- February 26, 2022: AltaSea Public Meeting - C. Anderson presented
- March 11, 2022: OASIS Ocean Acidification decade programme Meeting (OAR) - C. Anderson presented
- March 11, 2022: Climate and Fisheries Virtual Dialogue - C. Anderson presented
- March 16, 2022: NHABON Webinar #3 - C. Anderson Co-Chair
- March 16-17, 2022: Congressional Meetings - C. Anderson and L. Washburn
    - Rep. Barragan Office
    - Rep. Vargas Office
    - Rep. Levin Office
    - Rep. Jacobs Office
    - Rep. Lowenthal Office
    - Rep. Peters Office
    - Rep. Carbajal Office
    - Rep. Brownley Office
- March 25, 2022: NAML Membership Meeting - C. Anderson presented
- April 6th, 2022: NCEAS Roundtable - E. Satterthwaite presented
- April 12, 2022: US CLIVAR Ecological Forecasting Workshop, WHOI, MA - C. Anderson presented
- April 14, 2022: SCCOOS Board of Governors Meeting, Costa Mesa, CA - C. Anderson presented
- April 19, 2022: Micahel Clark, Environment Branch, US OMB, SIO visit, La Jolla, CA - C. Anderson presented

- April 26, 2022: West Watch Webinar - C. Anderson presented
- April 28, 2022: CA IFCB Network Meeting - C. Anderson Hosted and Presented
- May 1, 2022: Marine Medicine Conference, La Jolla, CA - C. Anderson Presented
- May 9-13, 2022: GlobalHAB Workshop, Glasgow, UK - C. Anderson Steering Committee Co-Chair
- May 23, 2022: Florida HABON: Building Florida's Interdisciplinary HAB Observing Network: Past, Present, and Future, virtual - C. Anderson Presented
- May 23-25: CalOOS Science Impact and Stakeholder Engagement Meeting, Avila Beach, CA - SCCOOS and CeNCOOS hosted and the following SCCOOS PI's presented:
    - Clarissa Anderson, UCSD
    - Dan Rudnick, UCSD
    - Rob Bochenek, ADS
    - Mark Merrifield, UCSD
    - Todd Martz, UCSD
    - David Caron, USC
    - Ally Pasulka, Cal Poly
- June 10, 2022: Scripps Pier Symposium, La Jolla, CA - C. Anderson and M. Carter Planning Committee, M. Carter Presented
- June 20-24, 2022: OCB Meeting, WHOI, MA - C. Anderson Presented
- June 28-29, 2022: NOAA Fisheries BGC Argo Workshop, La Jolla, CA
- June 27th - Jul 1, 2022: UN Ocean Conference Session on Ocean Obs - E. Satterthwaite presented

B. Education/Courses

- SIO171 - Intro to Physical Oceanography - Daniel Rudnick, SIO
- SIO175 - Analysis Ocean/Atmosph Data - Mark Merrfield, SIO
- SIO179 - Ocean Instruments and Sensors - Todd Martz, SIO
- SIO190 - Special Topic/Earth/Ocean/Atmo - Introduction to Acoustics - Mark Merrfield, SIO
- SIOB296 - Special Topics/Ocean Bio - Data Analysis/Modeling Techniques - Brice Semmens, SIO
- SIOG269 - Spec Topics/Marine Chemistry - Marine Chemistry Lab - Todd Martz, SIO
- MSCI403 - Ocean Sampling Techniques - Ally Pasulka and Ryan Walter, Cal Poly, SIO
- Worked with the California Central Coast Data Science Partnership at UCSB to bring CalCOFI data to their capstone projects. - Erin Satterthwaite/Brice Semmens, SIO
    - The CalCOFI Capstone projects developed online applications: https://reznikovl.github.io/calcofi1-book/intro.html & https://shiny.calcofi.io/capstone/

C. Outreach Materials

- New SCCOOS and CeNCOOS Joint Retractable Banner

D. Media Engagement

- Simon, M. Extreme Heat in the Oceans Is Out of Control, *Wired*. Feb 1, 2022 - **References D. Rudnick**
- Avitabile R. and Bravo C. Bioluminescence Back at San Diego Beaches and Dolphins Are Enjoying The Blue Waves. *NBC San Diego.* March 4, 2022 - **Features C. Anderson**
- Connelly, L. A red tide off OC and the South Bay has experts worried for sea birds. *The Orange County Register*. April 26, 2022 **- References C. Anderson**
- Yost, C. O.C. birds endangered by possible red tide. *KTLA*. April 27, 2022. **- References C. Anderson**
- Jennewein, C. Scripps Oceanography Monitoring 'Red Tide' at Southern California Beaches. *Times of San Diego.* April 30, 2022 - **References SCCOOS**
- Shukla, P. "Red Tides" Are Currently Blooming In Southern California. *Forbes*. April 30, 2022 **- References C. Anderson**
- Heid, N. Red Tide Arrives In So Cal: What? Where? How Bad? *Surf Fishing in SoCal*. May 1, 2022 **- References C. Anderson**

## VI. PRODUCT DELIVERY:

- New SCCOOS website template and layout (https://sccoos.org/)
- New joint SCCOOS and CeNCOOS data portal called the "California Ocean Observing Systems Data Portal" https://data.caloos.org/
- Five new CA HAB Bulletins published for the months Jan - May 2022
- Two updates of the MOCI Index (Multivariate Ocean Climate Indicator). Index available at: http://www.faralloninstitute.org/moci
    - Fall MOCI (Oct-Dec, Updated January 2022)
    - Winter MOCI (Jan-Mar, updated in April 2022)
- API developed to query CalCOFI data (https://api.calcofi.io/__docs__/)

## VII. CERTIFICATION UPDATES

- Memorandum of Agreement between U.S. IOOS and SCCOOS renewed as part of the RCOOS Certification (formally known as RICE)
- Lesley Ewing, California Coastal Commission, retired and left SCCOOS and CeNCOOS Joint Strategic Advisory Committee
- Jayme Timberlake, City of Encinitas, Coastal Zone Program Administrator, joined SCCOOS and CeNCOOS Joint Strategic Advisory Committee

## VIII. BUDGET SUMMARY

| Cost Categories | Funding provided | Funds spent | Unspent funds remaining | Remaining % |
|---|---|---|---|---|
| **Personnel** | 447,179.00 | 265,966.29 | 181,212.71 | 40.52% |
| **Fringe Benefits** | 187,246.00 | 112,860.54 | 74,385.46 | 39.73% |

| | | | | |
|---|---|---|---|---|
| **Travel** | 64,208.00 | 20,095.83 | 44,112.17 | 68.70% |
| **Equipment** | 144,061.00 | 0.00 | 144,061.00 | 100.00% |
| **Supplies** | 49,336.00 | 60,743.06 | (11,407.06) | 0.00% |
| **Contractual** | 1,212,890.00 | 305,178.76 | 907,711.24 | 74.84% |
| **Other** | 291,544.00 | 129,157.99 | 162,386.01 | 55.70% |
| **Total Directs Charges** | 2,415,986.00 | 894,002.47 | 1,521,983.53 | 63.00% |
| **Indirects Charges** | 552,319.00 | 314,780.90 | 237,538.10 | 43.01% |
| **Total Amounts** | 2,968,305.00 | 1,208,783.37 | 1,759,521.63 | 59.28% |

1. Were the oldest ASAP TAS BETC accounting lines drawn down first?

2. Give a brief update on project invoicing for the reporting period. Were there any delays with invoicing or payment?
   UC and Subawards did not receive project funds until October 2021.

3. Provide details on any property or equipment charged directly to the award having a useful life of more than one year and an acquisition cost of $5,000 or more per unit during the period.

4. Include changes in key scientific, technical or management personnel, not included in certification.
   - No changes.

5. Include changes to the organizational structure such as: changes in status or partners organizations and points of contact. As a reminder, a change to the award's Principal Investigator and a change in an award's Key Person Specified in the Application requires NOAA approval through Grants Online. Guidance for both these Award Action Requests is available on Grants Online
   - Dr. Clarissa Anderson, SCCOOS Executive Director, is now the lead PI which was approved by NOAA in February 2022.

6. Provide an update about travel completed during the reporting period.
   - February 8, 2022: IFCB re-deployed, IFCB cable installed, and SASS cleaning, Newport Beach Pier, CA (Carter, Martin)
   - February 18, 2022: IFCB recovered due to high humidity, Newport Beach Pier, CA (Carter, Martin)
   - March 10-11 & 15, 2022: CTD swap at Santa Monica (3/10), IFCB repairs at SCCWRP (3/10, 3/11), IFCB deployed at NB (3/11), SASS cleaning at NB (3/11). Return to SM (3/15) to recover CTD and swap out the y-cable and pump. Newport Beach Pier and Santa Monica Pier, CA (Carter, Martin)
   - April 12, 2022: US CLIVAR Ecological Forecasting Workshop, WHOI, MA (Anderson)

- April 14: SCCOOS Board of Governors Meeting, Costa Mesa, CA (Anderson, Washburn, Medina)
- April 14: SASS cleaning and maintenance, Newport Beach Pier, CA (Carter, Martin)
- May 5, 2022: Recovery of all instruments due to construction on Newport Beach Pier, SASS, SeaFET and IFCB, Newport Beach Pier, CA (Carter, Martin)
- May 9-13, 2022: GlobalHAB Workshop, Glasgow, UK (Anderson, Carter, Kenitz)
- May 16-19: NCEAS Working Group, Santa Barbara, CA (Anderson)
- May 22-25: CalOOS Science Impact and Stakeholder Engagement Meeting, Avila Beach, CA (Anderson, Medina, Timmerman, Washburn, Rudnick, Martz, Caron, Walter, Pasulka, Carter, Bochenek, Satterthwaite)
- June 8, 2022: Re-deployment of SASS, SeaFET and IFCB at Newport Beach Pier, CA (Carter, Martin)
- June 20-24, 2022: OCB Meeting, WHOI, MA (Anderson)

7. Give details on any delays with initiating a contract/subaward. Note any issues with the previous year funds or other issues that occurred during the reporting period. Will this result with a work stoppage or cause significant problems with the partnership?
   - Delays in getting funds to UC and Subawards

**IX. SUCCESS STORIES**

| Success Story | Brief Description | Contact |
|---|---|---|
| NA | | |

**X. Student Hires and Internships (advancing STEM education and retention at SCCOOS)**

- Alice Ren, SIO PhD 6/2022, thesis on variability of salinity and dissolved oxygen in the California Current System as observed by the California Underwater Glider Network.
- Yaseen Zaky, UCSD undergraduate student doing QC on Spray underwater glider data.
- Ben Werb, UCSD undergraduate degree 6/2022, entering MS student doing a thesis examining the water mass characteristics relevant to fisheries.
- Lucas Teran, USC undergraduate researcher, worked with Research Specialist Brittany Stewart on domoic acid analyses from the five piers.
- Mariana Lie, UCSD undergraduate student, assisted with Coastal Flood Network research
- Aidan Lewis, Axiom Data Science intern, assisting with email alerts when SASS stations are offline.
- Kasandra Lassagne, Axiom Data Science intern, assisted with data ingestion and visualization.

- Jessica Peria and Olivia Diehl, CSUN masters students, assisted with monthly cleaning and maintenance at the Santa Monica Pier SASS.
- Isidora Rojas and Alyssa Ayan, Scripps-Geosciences Educational Opportunities (Scripps-GEO) scholars from San Diego Community College, assisted Melissa Carter with HABMAP sampling efforts and program at Scripps Pier.
- Elyssa Romanini and Brian Person, Cal Poly undergraduate research students, collect and process samples for Cal Poly HABMAP
- Matthew Pfeiffer, Gabriel Anderson, and Nicholas Trautman; Cal Poly undergraduate research students that assisted HFR operations and maintenance
- Kenisha Shipley, pHD candidate in Todd Martz lab, assisted with Self-calibrating SeapHOx deployment at Scripps Pier and her dissertation focused on SCCOOS funded pH and oxygen data.

End Report

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**ADDENDA**

**XI. DMAC Annual Progress Report**
**ACTIVITIES DURING THE REPORTING PERIOD**

**Objective 1: Enable and Support SCCOOS Cyberinfrastructure and Statewide Data Portal**

- **Task 1.1: Provide technical support for SCCOOS Cyber Infrastructure.** [Status: On track] During this performance period, Axiom maintained ongoing continuous performance of the SCCOOS data system following IOOS DMAC guidelines. Additionally, Axiom initiated a new data center build out in August 2021 to increase data storage and compute resources for system optimization that is ongoing through this performance period.
- **Task 1.2: Implement and enhance a public-facing SCCOOS data portal for discovery and access.** [Status: On track] Axiom released a new integrated coastal and ocean observing data portal that unifies data streams across the California coast from CeNCOOS and SCCOOS regions. The CalOOS data portal is available at: https://data.caloos.org/. The data portal was launched to end users at the May 2022 stakeholders meeting.

**Objective 2: Ingest and Maintain SCCOOS-operated and Non-SCCOOS Data Assets, Including Sensors, Gliders, HR Radar, Models, Biological, and Historical Legacy Time Series**

- **Task 2.1: Ingest and maintain SCCOOS Data Assets.** [Status: On track] Axiom made progress ingesting and serving data collected by SCCOOS regional stations and replicating those data from the SIO data center to the Axiom data system for redundancy and back-up. This work included:
    - developed a new service on the Axiom infrastructure to calibrate chlorophyll, O2, and pH data that are being collected by SCCOOS Shore Stations. The code reads raw data files, calibrates parameters using a library, and then continuously writes out new files for ingestion and visualization into the CalOOS data portal. See Santa Monica Shore Station page as an example.
    - added six new IFCB data streams (San Francisco Pier 17, San Francisco Bay Cruises, Monterey Power Buoy, Santa Cruz Wharf, Stearns Wharf, Bodega Marine Lab) to SCCOOS IFCB dashboard and enabled an alert system for instrument monitoring.
    - updated a new CalHABMAP data layer to display phytoplankton abundance, Domoic Acid and nutrients including ammonium, nitrate, phosphate, and silicic acid monitoring data.
- **Task 2.2: Ingest and maintain non-SCCOOS Data Assets** [Status: On track] Axiom made progress ingesting and serving data collected by SCCOOS's regional data partners for discovery and access in the CalOOS data portal. This work included:
    - added CA ROMS forecast model to SCCOOS THREDDS server for interoperability.
    - visualized the West Coast Operational Forecast System (WCOFS) nowcast about the present and future states of a water body (generally including water levels, currents, water temperature and salinity).
    - ingested an updated C-HARM model nowcast and forecast prediction of the probability of Pseudo-nitzschia concentration.
    - ingested two U.S. Navy meteorological stations through SCCOOS data infrastructure: Nike Zeus and Laguna Peak.
    - visualized two data layers containing a 21-year time series of bird, mammal, fish, and crab pot observations from the Rockfish Recruitment and Ecosystem Assessment Survey (RREAS) aggregated by the Farallon Institute.

- visualized the Multivariate Ocean Climate Indicator (MOCI) that synthesizes a number of local and regional ocean and atmospheric conditions to represent the state of the California coastal ocean.
- completed initial work for the ingestion of real-time and historical/qc'd City of San Diego mooring data.

**Objective 3: Implement Real-Time Sensor Data Quality Control System**

- **Task 3.1: Deliver a subsystem to automate data quality tests for environmental data streams according to IOOS QARTOD specifications** [Status: On track] During this performance period, basic QARTOD tests were applied for 338 historical and real-time sensors that are accessible through the CalOOS data portal. Quality flags are summarized on both the station and sensor pages within the data portal for visual exploration. In addition, the documentation of the test code and thresholds are displayed on sensor pages (example) with links available to the v 1.0 version QARTOD GitHub library accessible through the portal. The source data files served through ERDDAP were updated to include the metadata attributes and quality flags for the QARTOD tests applied.

**Objective 4: Maintain and Enhance Existing Data Products and Develop New Data Applications**

- **Task 4.1: Support existing data products.** [Status: On track] Activities completed to support existing data products included:
  - developed an automated shore stations dashboard for a number of stations on the California coast that measure temperature, salinity, chlorophyll, and water level at frequent intervals in the nearshore coastal ocean: Southern CA, San Luis Obispo, Monterey Bay, Bodega and San Francisco Bay, Humboldt Bay
  - established a local instance of IFCB dashboard to host regional CA IFCB data streams: https://sccoos-ifcbdb.srv.axds.co/dashboard
  - developed a CalHABMAP dashboard to display phytoplankton concentrations at 8 monitoring sites and migrated data storage to an ERDDAP server on Axiom infrastructure: https://calhabs.svx.axds.co/erddap/
  - migrated SCCOOS MPA Shiny container to Axiom data system, where it exists alongside the CalOOS data portal: https://mpa-dashboard.caloos.org/
  - upgraded SCCOOS-hosted Wordpress installs and plugins to the latest versions.

**Objective 5: Provide DMAC Support to the SCCOOS Program**

- **Task 5.1: Participate in regional, state, national and international DMAC activities.** [Status: On track] Axiom participated in regular, weekly meetings with SCCOOS to discuss and communicate progress on project tasks. Rob Bochenek attended and presented at the May 23-25: California Ocean Observing Systems Science Impact and Stakeholder Engagement Meeting. In addition, a Jira project management board was maintained to track data management task progress. Axiom also participated in various regional meetings in support of SCCOOS DMAC: U.S. Navy NavAir Weather Bulletin, Marine Mammal Stranding Network, CA OOS Water Quality Focus Group Meeting, and the Cal OOS Tribal Co-Management/Co-Monitoring Focus Group, among others.

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**UPCOMING/PLANNED ACTIVITIES**

The upcoming SCCOOS DMAC activities planned for the next year include:

- Maintain and enhance the statewide CalOOS data portal.
- Reassessment of the QARTOD tests and parameter thresholds that are being applied to SCCOOS assets.
- Migration of the SCCOOS ERDDAP server from SIO to Axiom data infrastructure for regular maintenance and upkeep relative to IOOS DMAC standards.
- Ingest new datasets, as identified and prioritized by SCCOOS.
- Maintain and updates to calibration coefficients for automated shore stations data streams available through custom data dashboard for discovery and display of real-time SCCOOS Shore Station assets.
- Further development of CA IFCB dashboard and integration of Machine Learning (ML) data pipeline for data streaming into the HABDAC.
- Support for continued data submission, visualization, and metadata generation for SCCOOS funded projects.
- Participation on behalf of SCCOOS in state and regional groups as determined by SCCOOS, as well as national IOOS and IOOS Association data management committees and working groups and international organizations.
- SCCOOS is hiring a Product Developer who will work at UCSD/SIO/SCCOOS in collaboration with Axiom Data Science to develop new data tools and customized solutions for stakeholders and communicate with IOOS DMAC teams. They will also partner with CalCOFI on shared infographics and high-level, statewide products

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**SUCCESSES OR CHALLENGES**

The SCCOOS DMAC program has been successful in maintaining high availability of continuous integration observation stations throughout the region, and for continuing to foster relationships with data providers to add new data to the system. Metrics for data availability through the SCCOOS portal during this performance period (January 1, 2022 - June 30 2022) are listed below, in addition to. As Axiom began working to support SCCOOS DMAC in spring 2021, there are no prior year metrics to show for comparison.

**SCCOOS data portal metrics (January 1, 2022 - June 30, 2022)**

**Sensor Stations**

Total number of sensor stations: 1,455
Number of sensor types: 88
Number of affiliates: 56
Total stations with data from the past year: 611

**Moving Platforms**

Total number of moving platforms: 66
Total platforms with data from the past year: 11

**Data Layers**

Total number of data layers: 331
Number of affiliates: 30
Total datasets with data from the past year: 172

**Historic SCCOOS data portal metrics (June 1, 2021 - December 31, 2021) for reference:**

**Sensor Stations**
Total number of sensor stations: 1,261
Number of sensor types: 85
Number of affiliates: 57
Total stations with data from the past year: 397

**Moving Platforms**
Total number of moving platforms: 64
Total platforms with data from the past year: 8

**Data Layers**
Total number of data layers: 317
Number of affiliates: 29
Total datasets with data from the past year: 141

## XII. HFR Operations and Maintenance Expenditures

| Operator/Principal Investigator | Field Engineer/Technician Salary including fringe benefits & overhead* | O&M Oversight (PI or O&M manager) salary including fringe benefits & overhead* | Travel * | Supply and equipment expenses | # of radars | # of FTE | # of students (FTE) |
|---|---|---|---|---|---|---|---|
| Dr. Eric Terrill | $0 | $0 | $0 | $0 | 11 | 0.9 | 0 |
| Matthew Ragan | $0 | $0 | $0 | $0 | 6 | 0.9 | 0 |
| Dr. Libe Washburn | $10032.58 (IDC 25%) | $0 | $0 | $828 (IDC 25%) | 9 | 1.5 | 0 |
| Dr. Ryan Walter | $5293.55 | $658.19 (38.5% IDC) | $0 | $7799.69 | 5 | 0.5 | 0 |

*state indirect cost rate(s)

HFR Operators/PIs did not get accounts setup for FY2021 until late December, so limited funds were used during the reporting period. During the period 1 January 2022 to 30 June 2022 HFR Operators/PIs used funds from no-cost extensions to cover costs.

## XIII. HFR Asset and Staffing Inventory

**Cal Poly**

| **Staff Member** | **(% FTE or #person-months)** |
|---|---|
| Principal Investigator: Dr. Ryan Walter | 0.04 mo |
| Technicians/Engineers:<br>Ian Robbins<br>Grant Waltz | <br>0.36 mo<br>0 mo |

| | |
|---|---|
| Students | NA |

| Total # of Radars Supported: 5 | | | | | | |
|---|---|---|---|---|---|---|
| Operating Institution | Name | Latitude | Longitude | City | State | Frequency |
| Cal Poly | LUIS | 35.1608 | -120.7584 | Point San Luis (San Luis Obispo) | CA | 13.5MHz |
| Cal Poly | AGL1 | 34.5769 | -120.6491 | Pt. Arguello (Vandenberg Air Force Base) | CA | 4.8MHz |
| Cal Poly | ARG1 | 34.5769 | -120.6505 | Pt. Arguello (Vandenberg Air Force Base) | CA | 13.5MHz |
| Cal Poly | FBK1 | 34.8698 | -120.6212 | Fallback22, Pt. Sal (Vandenberg Air Force Base) | CA | 12.15MHz |
| Cal Poly | PTC1 | 34.4483 | -120.4717 | Point Conception (Lompoc) | CA | 13.45MHz |

**UCSB**

| **Staff Member** | **(% FTE or #person-months)** |
|---|---|
| Principal Investigator: Dr. Libe Washburn, Dr. Brian Emery | 0 mo.<br>0 mo. |
| Technicians/Engineers:<br>David Salazar<br>Eduardo Romero | <br>2 mo.<br>11 mo. |
| Students:Tim Ha<br>Rebecca He<br>Matthew Gerigk | NA |

| Total # of Radars Supported: 9 | | | | | | |
|---|---|---|---|---|---|---|
| Operating Institution | Name | Latitude | Longitude | City | State | Frequency |
| UCSB | RFG1 | 34.4612 | -120.0767 | Refugio Beach | CA | 13.500 MHz |
| UCSB | COP1 | 34.4078 | -119.8783 | Santa Barbara | CA | 13.450 MHz |
| UCSB | SSD1 | 34.4191 | -119.5966 | Santa Barbara | CA | 13.445 MHz |
| UCSB | TRL1 | mobile | mobile | Santa Barbara | CA | 13.445 MHz |
| UCSB | MGS1 | 34.2049 | -119.2516 | Oxnard | CA | 13.500 MHz |

| | | | | | | |
|---|---|---|---|---|---|---|
| UCSB | PTM1 | 34.0960 | -119.1070 | Point Mugu | CA | 13.500 MHz |
| UCSB | NIC1 | 34.0423 | -118.9154 | Malibu | CA | 13.500 MHz |
| UCSB | SCI1 | 33.9947 | -119.6321 | Santa Cruz Island | CA | 13.480 MHz |
| UCSB | SNI1 | 33.2805 | -119.5225 | San Nicolas Island | CA | 13.440 MHz |

**USC**

| **Staff Member** | **(% FTE or #person-months)** |
|---|---|
| Principal Investigator: Matt Ragan | 2 mo. |
| Technicians/Engineers:<br>Matt Ragan | <br>9 mo. |
| Students: | NA |

| Total # of Radars Supported: 6 | | | | | | |
|---|---|---|---|---|---|---|
| Operating Institution | Name | Latitude | Longitude | City | State | Frequency |
| USC | SCCI | 33.4468 | -118.4782 | Avalon | CA | 13.5MHz |
| USC | SCDB | 34.033 | -118.7337 | Malibu | CA | 25.39MHz |
| USC | SCDH | 33.9432 | -118.4424 | Playa del Rey | CA | 13.5MHz |
| USC | SCNB | 33.606 | -117.9314 | Newport Beach | CA | 25.1MHz |
| USC | SCPF | 33.709 | -118.294 | San Pedro | CA | 25.39MHz |
| USC | SCTB | 33.8117 | 118.259 | Redondo Beach | CA | 25.9MHz |

**SIO**

| **Staff Member** | **(% FTE or #person-months)** |
|---|---|
| Principal Investigator: Dr. Eric Terrill<br>Lisa Hazard | 0.1 mo.<br>0.25 mo. |
| Technicians/Engineers:<br>Carlos Garcia-Moreno<br>Thomas Cook*<br>Joseph Chen (programmer) | <br>2.0 mo.<br>0 mo.* *no longer with SIO*<br>0.2 mo. |
| Students: | NA |

| Total # of Radars Supported: 11 |
|---|

| Operating Institution | Name | Latitude | Longitude | City | State | Frequency |
|---|---|---|---|---|---|---|
| SIO | SDCI | 32.4141 | -117.2437 | Coronado Is. | MX | 24.4MHz |
| SIO | SDBP | 32.5359 | -117.1223 | Imperial Beach | CA | 24.6MHz |
| SIO | SDPL | 32.6658 | -117.2396 | San Diego | CA | 24.6MHz |
| SIO | SDWW | 32.6799 | -117.2474 | San Diego | CA | 24.6MHz |
| SIO | SDSL | 32.8694 | -117.2532 | La Jolla | CA | 4.64MHz |
| SIO | SDSE | 33.0245 | -117.2861 | Encinitas | CA | 25.6MHz |
| SIO | SDCP | 33.2577 | -117.4368 | Camp Pendleton | CA | 25.4MHz |
| SIO | SDSC | 32.9177 | -118.4869 | San Clemente | CA | 5.23MHz |
| SIO | SDSN | 33.0298 | -118.5971 | San Clemente | CA | 4.48MHz |
| SIO | SDUT | 33.3882 | -117.5955 | San Clemente | CA | 25.6MHz |
| SIO | SDDP | 33.4607 | -117.7067 | Dana Point | CA | 25.4MHz |

**IX. Observing Asset Inventory**

SCCOOS 2022 Asset Inventory Spreadsheet