SOUTHERN CALIFORNIA COASTAL OCEAN OBSERVING SYSTEM: A Science-Based Decision Support System

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1-October 2021

Debra Esty
Regional Grants Administrator
U.S. IOOS® Program Office
1315 East-West Highway, 2nd Floor
Silver Spring, MD 20910

#NA21NOS0120088

Dear Debra,

On behalf of the Southern California Coastal Ocean Observing System (SCCOOS), we would like to submit the following scope of work to the U.S. Integrated Ocean Observing System (IOOS®) Program for Fiscal Year (FY) 2021. This letter outlines the projects that will be conducted at the recommended funding amount of $2,968,305.

For FY 2021, SCCOOS received a single core funding amount of $2,820,805, which is the sum of past year's RCOOS, HF Radar Operations O&M, and Fill the Gaps-Adjustment to Base. These funds will be used to maintain and grow our Governance and Management Subsystem, Observations Subsystem, Data Management and Cyberinfrastructure (DMAC) Subsystem, and Modeling and Analysis Subsystem. Our Observation Subsystem is broken down into four thematic focus areas as they define our core capabilities: 1) Marine Operations, 2) Coastal Hazards, 3) Ecosystems, Fisheries, and Water Quality, and 4) Climate Variability and Change. FY21 funds will support the following 15 proposed tier 1 projects from our FY21-26 proposal:

Governance and Management Subsystem
1. Regional Association Organization & Outreach/Education
   a. We will sustain the SCCOOS program office and governance in support of our core capabilities, provide uninterrupted product and data delivery via our DMAC system, and ensure frequent, meaningful stakeholder outreach. – PI: *Anderson (UCSD), FY21-26*
   b. Develop formal mechanisms for routine stakeholder feedback via analytical tools, surveys, and digital media. – PI: *Anderson, FY 21-26*
   c. Continue to build strategic partnerships at all regulatory levels, leveraging strengths in observing and technology development with industry. – PI: *Anderson (UCSD), FY21-26*

Observations Subsystem
Marine Operations
2. HF Radar Operations & Maintenance
   a. Sustain and operate High Frequency Radar (HFR) sites comprising the SCCOOS component of the surface current mapping network in support of US Coast Guard Search and Rescue, CA Office of Spill Prevention and Response, NOAA Office of Response and Restoration, boaters, shipping and ecosystem management, in partnership with CeNCOOS. – PI: *Terrill (UCSD), Ragan (USC), Washburn (UCSB), Walters (Cal Poly SLO), FY21-26*
Climate Variability and Change
3. California Underwater Glider Network (CUGN)

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a. Sustain and operate two operational glider lines in the CUGN (Line 80 and alongshore line) in support of improving ecosystem/ocean prediction – PI: *Rudnick (UCSD), FY21-26*

Ecosystems, Fisheries, and Water Quality

4. Harmful Algal bloom (HAB) Monitoring Program + SPATT
   a. Continue to provide weekly information to State and federal stakeholders on critical HAB taxa and toxins at HABMAP pier sites in the SCCOOS region, in partnership with CeNCOOS. – PI: *Anderson/Carter (UCSD), Shipe (UCLA), Caron (USC), Brzezinski (UCSB), Walter/Pasulka (Cal Poly SLO), FY21-26*

5. SCCOOS Automated Shore Stations (SASS)
   a. Operate and maintain four automated shore stations at nearshore pier sites in the SCCOOS region to continuously record EOVs - temperature, salinity, chlorophyll, turbidity - in support of water quality management, HAB early warning, and the public. – PI: *Anderson/Carter (UCSD), Nickols (CSUN), Washburn (UCSB), FY21-26*

6. OAH Monitoring on SASS Stations
   a. Integrate, operate, and maintain innovative sensors for monitoring pH and oxygen levels at three automated shore stations in the SCCOOS region in support of water quality management and ecosystem monitoring, synergistic with CeNCOOS ocean acidification and hypoxia monitoring. – PI: *Martz (UCSD), FY21-26*

7. CalCOFI- Distribution and abundance of marine birds in the Southern California Bight and adjacent waters
   a. Continue collecting observations of seabird and marine mammal abundance on quarterly CalCOFI cruises and integrate into fisheries and ecosystem assessments. – PI: *Sydeman (Farallon Institute), FY21-26*

8. California Multivariate Ocean Climate Indicator (MOCI)
   a. Maintain the development and dissemination of the California Multivariate Ocean Climate Indicator (MOCI) in collaboration with CeNCOOS and in support of fisheries and National Marine Sanctuaries. – PI: *Garcia-Reyes (Farallon Institute), FY21-26*

9. Statewide Kelp Canopy Area/Biomass Dynamics
   a. Incorporate kelp biomass database into our portal and develop user-driven discovery tools and displays in collaboration with CeNCOOS. – PI: *Bell (WHOI), FY21-26*

Coastal Hazards

10. California Coastal Flood Network
    a. Continue to support and expand the California Coastal Flood Network. – PI: *Merrifield (UCSD), FY21-26*

DMAC Subsystem

11. SCCOOS DMAC
    a. Work in conjunction with SIO IT to establish and maintain SCCOOS servers in a configuration designed to facilitate optimal use of compute resources based on both the needs of SCCOOS stakeholders and IOOS requirements for RA DMAC. – PI: *Anderson (UCSD), FY21-26*
    b. Leverage hardware refresh to improve cyberinfrastructure architecture to expand capacity of the systems that serve and provision SCCOOS data. – PI: *Anderson (UCSD), FY21-26*
    c. Evaluate remaining legacy systems to determine the best path forward in terms of modernizing infrastructure and meeting stakeholder requirements. – PI: *Anderson (UCSD), FY21-26*
    d. Maintain, support, and expand the SCCOOS website and portal. – PI: *Anderson (UCSD), FY21-26*
    e. Collaborate with Axiom Data Science on a unified California/statewide data portal that harmonizes SCCOOS and CeNCOOS data catalogs. – PI: *Anderson (UCSD), FY21-26*

f. Work with providers of biological data to further standardize data collection and processing methods to improve validity of data comparisons between sites. – PI: *Anderson (UCSD), FY21-26*

g. Participate in the Standardizing Marine Biological Data Working Group to facilitate adoption of data representation standards by the biological data community, including use of Darwin Core to make biological data more widely discoverable and accessible. – PI: *Anderson (UCSD), FY21-26*

h. Participate in working groups related to physical, chemical, and biological data to assist with "guidance, best practice documentation, training, and community building" for the U.S. biological data community. – PI: *Anderson (UCSD)*

i. Support the development of a national HAB DAC, including automated classification of organisms photographed using machine learning techniques. – PI: *Anderson (UCSD), FY21-26*

j. Mirror the CUGN ERDDAP and climatology page in support of pan-regional product development that increases exposure to glider technology and the National Glider DAC. – PI: *Anderson (UCSD), FY21-26*

k. Support the HFR team and institutional efforts to improve HFRNet. – PI: *Anderson (UCSD), FY21-26*

12. Axiom Data Science (ADS)

a. Continue to standardize, automate, and generalize the existing data pipeline, including data acquisition, processing and quality assurance methodologies using the NOAA Environmental Data Management Framework as a guide. – PI: *Bochenek, (ADS), FY21-26*

b. Enable and Support SCCOOS Cyberinfrastructure and Statewide Data Portal – PI: *Bochenek, (ADS), FY21-26*

c. Ingest and Maintain SCCOOS-operated and Non-SCCOOS Data Assets, Including Sensors, Gliders, HR Radar, Models, Biological, and Historical Legacy Time Series – PI: *Bochenek, (ADS), FY21-26*

d. Implement Real-Time Sensor Data Quality Control System – PI: *Bochenek, (ADS), FY21-26*

e. Data Applications – PI: *Bochenek, (ADS), FY21-26*

13. CalCOFI - Data Synthesis and Serving/Product Development

a. Data synthesis and product development in support of CalCOFI, fisheries, and National Marine Sanctuaries. – PI: *Semmens (UCSD), FY21-26*

Modeling and Analysis Subsystem

14. ROMS - 3 km Statewide Operational model

a. Continue to support and serve real-time, data-assimilative Regional Ocean Model System (ROMS) predictions to SCCOOS and CeNCOOS end-users. – PI: *Chao (Seatrec, Inc.), FY21*

b. Support real-time ROMS and evaluation as we bridge the transition to the operational NOAA West Coast Ocean Forecast System (WCOFS). – PI: *Chao (Seatrec, Inc.), FY21*

15. ROMS - High Resolution Shelf and Nearshore Physics

a. Continue to provide critical support to nearshore ROMS development for improved physics of direct relevance to water quality managers and SCCOOS partners. – PI: *McWilliams (UCLA), FY21-26*

SCCOOS also received non-core funding in the amount of $10,000 to support a CDIP wave buoy in the Port of Long Beach and $137,500 as part of the HABON Pilot Project to aid in the support of the fledgling California Imaging Flow Cytobot Network now under development; SCCOOS will use these funds to support a data scientist and a technical expert to ensure that the network is coordinated and interoperable.

No tier 2 proposed project initiatives will be supported this year. Below is a list of the tier 2 projects and tasks proposed in our FY21-26 proposal.

Governance and Management Subsystem
Outreach and Education
1. Outreach & Education with Birch Aquarium + AltaSea
   a. Act as a facilitator between our stakeholders and researchers and regional underserved and underrepresented K12 communities in STEM through programs showcasing ocean observing related careers and informal learning between SCCOOS and (1) Ocean Discovery Institute, (2) AltaSea, (3) Birch Aquarium, (4) Heal the Bay. – PI: *Peach (UCSD/Birch), FY22-26*
   b. Integrate undergraduate and graduate students related to our funded projects in our programmatic research and engage them in a biweekly professional development course run by the outreach personnel. – PI: *Peach (UCSD/Birch), FY22-26*
2. Outreach Evaluation and Assessment Plan
   a. Contract an assessment and evaluation specialist from CREATE to consult on our education programs to create formative and summative assessments for our various outreach activities and programs. – PI: *Sweet (UCSD/CREATE), FY21-25*
3. Regional Association Organization & Outreach/Education
   a. Over the next five years, we anticipate growth in the program office to adequately adapt to program expansion, particularly if projects listed as Tier 2 come to fruition. – PI: *Anderson (UCSD), FY21-26*
   b. Codify an annual schedule of workshop-based communications with targeted stakeholder groups to strategically initiate new products and leverage partner resources. – PI: *Anderson (UCSD), FY21-26*
   c. Collaborate with SciREN San Diego on data-based lesson plans that will allow local teachers to interface with SCCOOS researchers. – PI: *Anderson (UCSD), FY21-26*

Observations Subsystem
Marine Operations
4. HF Radar Recap
   a. Update the HF Radar network via recapitalizing aging infrastructure and hardening the network, in partnership with CeNCOOS. – PI: *Terrill (UCSD), Ragan (USC), Washburn (UCSB), Walters (Cal Poly SLO), FY21-26*
Climate Variability and Change
5. Glider Recap
   a. Update the CUGN via recapitalizing aging infrastructure with state-of-the-art Spray gliders. – PI: *Rudnick (UCSD), FY21-26*
6. Towards autonomous biogeochemical and ecological monitoring in the California Current System using underwater gliders (BioEco)
   a. Integrate biogeochemical and ecological (BioEco) sensors onto Spray Gliders in the CUGN to measure pH and dissolved oxygen in partnership with CeNCOOS. – PI: *Takesshita (MBARI), FY21-26*
7. A network of low-cost near-shore monitoring stations for ocean acidification, hypoxia, and water quality
   a. Implement a network of low-cost near-shore mini-moorings for monitoring ocean acidification, hypoxia, and water quality in the SCCOOS region. – PI: *Lankhorst/Send (UCSD), FY21-26*
8. California Fishing Vessels of Opportunity (CFVOP)

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a. Sustain industry and citizen-science partnerships for monitoring EOVs in the water column on California Fishing Vessels of Opportunity (CVOF) in support of commercial fisheries and in partnership with CeNCOOS. – PI: *Van Vranken (Bering Data Collective), FY21-26*

9. A moored SCCOOS reference and development site with a 14-year long record off Del Mar
   a. Sustain a coastal mooring in the SCCOOS region that hosts a 14-yr time series in support of water quality management and improving ocean prediction. – PI: *Send (UCSD), FY21-26*

10. Effect of upwelling intensity on near-shore acidification and deoxygenation in the Southern California Bight
    a. Maintain bi-weekly small-boat surveys of cross-shore and along-shore variability in biogeochemical parameters in support of nearshore OAH modeling. – PI: *Andersson (UCSD)***, *FY21-26*

Ecosystems, Fisheries, and Water Quality

11. Indicators of Zooplankton from California's Underwater Glider Network
    a. Combine CUGN ADCP data, CalCOFI net data, and CalCOFI acoustic data processed for krill to create zooplankton indicators in partnership with CeNCOOS. – PI: *Dorman (Farallon Institute), FY21-26*

12. Harmful Algal Bloom (HAB) Monitoring
    a. Continue to provide weekly information to State and federal stakeholders on critical HAB taxa and toxins at HABMAP pier sites in the SCCOOS region, in partnership with CeNCOOS. – PI: *Anderson/Carter (UCSD), Shipe (UCLA), Caron (USC), Brzezinski (UCSB), Walter/Pasulka (Cal Poly SLO), FY21-26*
    b. Expand capacity for dissolved toxin tracking and molecular sampling at HABMAP sites in the SCCOOS region. – PI: *Anderson/Carter (UCSD), Shipe (UCLA), Caron (USC), Brzezinski (UCSB), Walter/Pasulka (Cal Poly SLO), FY21-26*

13. Enhancing SCCOOS with high throughput molecular and flow cytometry observations
    a. Develop microbial community structure and abundance data products to rapidly assess risk of HABs and other biologically mediated events at SCCOOS pier sites in support of the CA HAB Early Warning System. – PI: *Bowman (UCSD), Pasulka (Cal Poly SLO)*

14. Marine mammals as high trophic, early, biological sensors of algal biotoxin production in the California coastal ocean
    a. Measure domoic acid levels in biological samples from live and fresh dead marine mammals as an objective biological indicator of HAB activity in the California coastal ocean. – PI: *Nollens (PMMC), FY21-26*

15. Automated Shore Stations - Recap
    a. Update and recapitalize sensors on nearshore pier sites. – PI: *Anderson/Carter (UCSD), Nickols (CSUN), Washburn (UCSB)*

16. Harmful Algal Bloom (HAB) Monitoring with the IFCB Network in southern California
    a. Support O&M of the southern California sites with IFCBs through technical support (focus on Del Mar mooring) and data management and analysis support

17. Observing nutrient fluxes and their role in HAB development in the nearshore region of Southern California.
    a. Deploy high-frequency instruments at multiple sites to observe nutrient fluxes and their role in HAB development in the nearshore SCCOOS region HAB development on shelf. – PI: *Lucas/Send (UCSD), Davis (UCI), FY21-26*

18. Develop and maintain a low-cost, citizen-science based sensor network on rocky reefs for monitoring bottom temperature and, oxygen

a. Develop and maintain a low-cost, citizen-science based sensor network on rocky reefs for monitoring bottom temperature and oxygen in support of water quality management and improved ocean prediction. – PI: *Johnston (UCSD)*, *FY21-26*

19. Large scale and long-term kelp forest monitoring for science and policy
    a. Conduct ecological surveys in support of the CA MPA network in the SCCOOS region. – PI: *Casselle (UCSB), FY21-26*
20. California Kelp Forest Marine Protected Area OAH Network with Citizen Science
    a. Maintain a citizen-science based ocean acidification and hypoxia sensor network at two CA Marine Protected Area (MPA) sites in the SCCOOS region, in partnership with CeNCOOS. – PI: *Friewald (ReefCheck), FY21-26*
21. Animal Tracking Network (ATN) - White Shark Acoustic Receiver Array
    a. Build out a buoy-based network of acoustic receiver arrays for tracking tagged Great White Sharks and nearshore tagged species in the national Animal Telemetry Network (ATN), in partnership with CeNCOOS and NANOOS. – PI: *Lowe (CSULB), FY21-26*
22. Ocean Sound Observation Network
    a. Sustain the Ocean Sound Observation Network (OSON) in support of National Marine Sanctuaries and the U.S. Marine Biodiversity Observation Network (MBON), in partnership with CeNCOOS and NANOOS. – PI: *Peavey Reeves/Haver (ONMS/NMFS), Baumann-Pickering (UCSD), FY21-26*
23. eDNA Library Development on ichthyoplankton at SCCOOS-CalCOFI stations in partnership with SBC-MBON
    a. Advance genomic methods for monitoring biodiversity in support of MBON and NMFS. – PI: *Thompson (SWFSC) FY21-26*

DMAC Subsystem
24. SCCOOS DMAC
    a. Increase SCCOOS DMAC capacity to develop new products and partner with industry to develop web applications that extend the reach of SCCOOS data and model products. – PI: *Anderson (UCSD), FY21-26*

Modeling and Analysis Subsystem
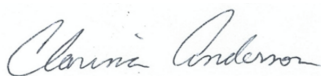25. ROMS - BEC Biogeochemical Model Development
    a. Support development of a coupled ROMS and Biogeochemical and Lower Ecosystem (BEC) model for improved biogeochemical predictions and regional ecological forecasting in support of water quality managers, fisheries, and regional partners. – PI: *Bianchi (UCLA), FY21-26*
26. Numerical Ocean Model Simulations as a Research Asset for California Current System Scientists and Managers
    a. Serve ROMS-BEC predictions of coupled physics and biogeochemistry to the public via the SCCOOS data portal in support of state OAH modeling, water quality management, and fisheries. – PI: *Kessouri (SCCWRP), FY21-26*

Despite the reductions required by lower funding levels than originally proposed, IOOS awards provide a critical source of funds for sustaining core operations and a valuable resource for leveraging additional grants and building new partnerships. Thank you for your continued support.

Sincerely,

Clarissa Anderson, PhD – Co-PI
SCCOOS Executive Director

Eric Terrill, PhD – PI
SCCOOS Technical Director

FY 2016-2021 MILESTONE SCHEDULE

SCCOOS FY21 proposed project milestones/deliverables for the Observing Subsystem and Modeling/Analysis Subsystem. Instrument acquisition and data/product delivery occur at a range of frequencies: hourly, daily, weekly, monthly, quarterly and/or annually.

FY21 Observing and Modeling/Analysis Subsystem Milestones and Deliverables	Hourly	Daily-Weekly	Monthly-Quarterly	Annually
Sustain & operate 31 High Frequency Radar in the SCCOOS Region - continuous service via HFRNet, SCCOOS, and CeNCOOS		✓		
SIO - Sustain & operate two Spray glider lines in the SCCOOS region - continuous service with 3-5 month deployments per Spray		✓		
SIO/USC/UCLA/UCSB/CalPoly - Sustain weekly HAB species, particulate toxins, & SPATT dissolved toxin sampling at five HABMAP pier sites in the SCCOOS region; plankton classification delivered weekly, SPATT every two weeks, and DA data every 1-4months		✓	✓	
SIO/CSUN/UCSB - Operate & maintain four SCCOOS Automated Shore Stations (SASS) - continous data service at a 6 min ingestion frequency, with routine (monthly) sensor cleaning and maintenance	✓		✓	
SIO - Integrate, operate & maintain (SCS) pH & oxygen sensors at 3 SASS stations in the SCCOOS region; data will be provided continuously, with routine instrument cleaning and servicing (e.g. reagent replacement)	✓		✓	
Farallon Inst - Collect seabird & marine mammal abundance on quarterly CalCOFI cruises and deliver annual reports to SCCOOS for incorporating into CCIEA and NMS reports			✓	✓
SIO - Support & expand the California Coastal Flood Network, adding a new site to the threshold validation/evaluation process each year	✓			✓
UCLA - 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	✓	✓		✓
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				✓
SCCOOS PO/UCLA - Support real-time ROMS & evaluation as we bridge the transition to the operational NOAA WCOFS			✓	✓
SCCOOS PO - Evaluate stakeholder requirements for circulation & ecosystem models via the on-going IOOS COMT project; workshops on-going			✓	
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		✓	✓	
Farallon Inst - Update and disseminate the Multivariate Ocean Climate Indicator (MOCI) - CeNCOOS collaboration- for incoropoation into customized data synthesis products and curated data views			✓	
WHOI - Incorporate kelp biomass database into our portal & develop user-driven discovery tools & displays - CeNCOOS collaboration - for incroporation into customized data synthesis products, curated data views, and made available fro all relevant assessments, e.g. MPAs			✓	

SCCOOS FY21 Program Office Milestones.

Program Office Milestones - Governance and Management	Year 1			
	W	Sp	Su	F
Progress Reports to IOOS Program Office		✓		✓

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Task	Q1	Q2	Q3	Q4
Submit Descope Budget to IOOS			■	
Weekly Program Office Conference Call with ESC and BOG Elected Chair Members	■	■	■	■
SCCOOS Stakeholder Outreach Meetings	■	■	■	■
SCCOOS BOG Meeting	■			
SCCOOS ESC and BEC Meetings		■		
SCCOOS PI Meeting		■		
SCCOOS and CeNCOOS JSAC Meeting		■		
IOOS Spring Meeting and Congressional Outreach		■		
Fall IOOS Meeting				■
IOOS Regional Directors Retreat			■	

Program Office Milestones - Engagement and Outreach				
Informal Education Activities				
Data visualizations and exhibits at Birch Aquarium and AltaSea			■	■
Public and Stakeholder Engagement				
Presentations and Panels	■	■	■	■
Exhibit Booths (e.g., NOAA's Day, AltaSea, Heal the Bay)		■		
Quarterly Newsletter	■	■	■	■
Media and News Articles Interviews	■	■	■	■
SCCOOS website posts and pages	■	■	■	■
Website Inquiries	■	■	■	■
Social Media (Twitter and Facebook) posts and listserv emails	■	■	■	■
Provide Tours of SCCOOS Assets at SIO and Host Working Q&A Luncheon	■	■	■	■
Host Opportunistic Experiential Field Trips for Congressional Representatives		■		■
Engagement of Academics and Researchers (PIs)				
Publications	■	■	■	■
Attend Meetings, Workshops, Seminars, etc.	■	■	■	■
Data Management and Cyberinfrastructure				
DMAC Upgrades (servers, hardware, software)				■
RICE Renewal Process				
Maintain and iterate on decision-support tools developed and hosted by SCCOOS	■	■	■	■
Data delivery to NCEI and other national repositories				■
Routine data delivery to national DACs	■	■	■	■
Migrate NDBC to ERDDAP		■		
Upgrade to IOOS Metadata Profile Version 1.2			■	
DMAC Working Group and DAC Support telecons	■			
IOOS DMAC Meeting + Code Sprints		■		