

**Department of Commerce
Research Performance Progress Report – Grants Online Electronic Template**

Award Information: Complete Boxes 1 – 23 with the requested information

Box 1. Federal Agency – Department of Commerce/NOAA

Box 2. Federal Award Number – Assigned Award Number for the project

Box 3. Project Title

Launching WebCOOS: Webcams for Coastal Observations and Operational Support

Box 4. Award Period of Performance Start Date

Box 5. Award Period of Performance End Date

August 30, 2023

Box 6. Principal Investigator's Last Name

Hernandez

Box 7. Principal Investigator's (PI) First and Middle Name

Debra

Box 8. PI Job Title

SECOORA Executive Director

Box 9. PI's Email

debra@secoora.org

Box 10. PI's Phone Number

843.906.8686

Box 11. Authorizing Official's (AO) Last Name

Box 12. AO First and Middle Name

Box 13. AO Job Title

Box 14. AO Email

Box 15. Signature of Recipient Authorized Representative – Non Applicable

Box 16. Submission Date and Time Stamp

Box 17. Reporting Period End Date

Box 18. Reporting Frequency – Semi-annual

Box 19. Report Type – Not Final or Final

Not final

Box 20. Recipient Name

SECOORA

Box 21. Recipient Address

Post Office Box 13856, Charleston, SC 29422

Box 22. Recipient DUNS

Box 23. Recipient EIN

Accomplishments: Boxes 24 – 27 are required for the first initial progress report. Subsequent reports will be prepopulated with the information from the previous report and have a limit of 4,000 characters. Comment Box 28 is required but will not be pre-populated in subsequent reports.

Box 24. What were the major goals and objectives of this project?

Box 25. What was accomplished under these goals?

Goal 1) Engage demonstrated webcam operators and other end-users

Obj. 1.1) Identify & engage Tier 1 & 2 users: 70% Complete

- Continued to work on getting a webcam setup for the Wrightsville Beach USCG station by testing the stream with Axiom, documenting webcam metadata, and working with NWS-Wilmington on an installation plan.
- Tested the webcam stream with Axiom for a new wifi webcam to be installed by a homeowner in Florida. The metadata for that stream was documented and instructions, with screenshots, were developed to instruct homeowners how to install this type of webcam and connect with WebCOOS.
- Received approval to set up a webcam on the Walton Lighthouse in Santa Cruz. Installation was challenging since there is no power and internet connection. We ended up with an IP webcam that sends data via wifi (since lte/5g has speed throttling once we reach some limit even for “unlimited” plans). Power is being provided via 2x100 solar panels and a 100ah lifo battery. Internet connection is being provided courtesy of O’neill Sea Odyssey with signals boosted via a directional antenna on top of their building and an amplifier at the lighthouse. The IP webcam software does not provide a programmable shutoff/on option so we added a wifi switch for

dusk/dawn operations in order to conserve battery power. The software also routes video through the company server which drops the fps down to 4fps so we are currently setting up a separate server at O'neill to see if we can bypass that drop.

- Continued engagement with Rosemont community members and Tier 2 stakeholders. Hosted Rosemont community event with SECOORA Board.
- Participated in monthly meetings with Coastal Imaging Research Network (CIRN); Greg Dusek, project collaborator, gave a webinar as part of their on-going seminar series.
- UNCW Graduate student Jeremy Braun presented his work at three scientific meetings and, through networking, passed along two additional webcam operators interested in engaging with WebCOOS.
- Continued monthly team meetings and held an in person team meeting on October 11 and 12 in Charleston, SC with the core project team and representatives from USGS and USACE. The agenda included lightning talks from PIs on their progress to date, presentations on USGS and USACE webcam networks, a deep dive into specific products and the responsible party for year 3 tasks of the project, and a session on planning for the future of WebCOOS.

Obj 1.2) Develop, assess and disseminate stakeholder appropriate outreach and education materials: 70% Complete

- Developed new signage and educational one pager for community-based monitoring assets for the Rosemont Community.
- Provided shoreline change products derived to the U.S. Army Corps of Engineers partner for review and feedback.
- The WebCOOS [website](#) was shared as Hurricane Ian was approaching in an article that includes how you can use webcams to document [hurricane impacts and assess shoreline change](#).
- The team developed and published two news stories: [Camera Footage of Marine Mammal Releases Available to View on WebCOOS](#) and [Strength in Numbers: The Power of Joining Forces](#).
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Objective 1.3) Identify testers within the network and conduct survey to assess ease-of-use, utility of various analyses and informational products, and willingness to pay for webcam imagery or downstream product access or customization: 20% Complete

- In addition to the drone flights, we recruited novices (with respect to rip current detection) in the field to measure how much machine learning is aiding them. A recent field test was run with 2 lifeguards and the droneML efficiency matched that of the lifeguards' and exceeded those of the novices. Currently, droneML takes a stable video of each detected rip and the next step is to instruct droneML to fly around each detected rip in a circle and collect video of these from different elevations. The purpose is to collect data from lower elevations where the rips may be harder to spot e.g. from webcam locations or from beach goers.
- Developed instructions, with screenshots, to instruct homeowners how to install webcam and connect with WebCOOS.

Goal 2) Operationalize the WebCAT system to a national webcam data management network

Obj 2.1) Select camera providers and maintain webcams: 95% Complete

- Installed a Reolink E1 outdoor webcam Georgetown, SC at the [South Carolina Maritime Museum](#).
- Ingested Holland, MI State Park; South Carolina Maritime Museum, Georgetown, SC; and 2 new UNCW webcams into the WebCOOS system.
- Continued discussions working with the Miami WFO and Loews hotel to install a new webcam focused on rip currents for lifeguard operations. Currently awaiting a quote from the local webcam installation company.
- Maintained and improved access to all webcam streams.
- Submitted a proposal to scale WebCOOS from a regional to a national webcam coastal observation network to the Federal Funding Opportunity FY2023 Ocean Technology Transition Project.

Obj 2.2) Develop interactive web portal to access live webcam feeds, historical archive footage, and webcam products: 95% Complete

- Maintained WebCOOS portal and access to all webcams.
- Made improvements to the webcam page by adding the ability to sort by assets, feeds, products, and services.
- Improved data access, ease of use, and navigation.
- Developed data catalog and API for accessing webcams; imagery; and video data access.

Obj 2.3) Standardize webcam imagery and metadata documentation and delivery: 80% Complete

- Provided webcam metadata for two new and soon-to-be installed webcams.
- Maintained a continuous iteration of schema-based webcam metadata profile; Display of standard image products: Live video, 10 minute clips, and stills available on individual webcam pages.

Obj 2.4) Develop end-to-end data management workflow integration: 75% Complete

- Provided software engineering and cyberinfrastructure support for the data management and analysis system.
- Data management workflow is completely documented and available via the [WebCOOS website](#). Each webcam can be a bit unique so each ingestion involves hands-on support from Axiom staff and will lead to updates in the documentation as more is learned about these webcam systems.
- Continue testing and operationalizing of the ingestion process for additional data products including code and georectified imagery.

Obj. 2.5) Integrate quality assurance and quality control (QA/QC) mechanisms: 40% Complete

- A publication on hybrid rip detector (RipViz) was accepted for publication at IEEE TVCG. The rip current team continues to do tests for swimmers/surfers/boats in the water, or joggers/cars on the beach, birds, etc.
- Integrated filtering of shoreline based on tidal stage to remove noise from tidal shifts. Also implemented manual QA/QC steps for shoreline detection. Documenting the percentage removed as a test for the algorithms.

Goal 3) Automate and validate downstream processing of webcam data;

Obj 3.1 Further develop detection algorithms: 85% Complete

- DroneML has both bathymetry and sediment (flash) rip detection now. FRCNN had to be updated to use TensorFlow2 and is now awaiting GPU cycles for retraining with sediment rips. Data collection for other types of rips, as well as bathymetry/sediment rips from lower elevation continues.
- Updated software at Isle of Palms parking activity to better count car entrances/exits.
- Continued testing and validation with Oak Island webcams.
- Graduate student Jeremy Braun also traveled to the Currituck webcams (using a graduate student grant he was awarded) to collect ground control points in the field of view to expand future testing.

Obj 3.2) Develop operational prototype products: 70% Complete

- Developed shoreline change product using 2 years of data.
- Working with science PIs to host and operationalize data products for wider availability.

Obj 3.3) Validation of prototype: 40% Complete

- Ran field test of DroneML at Seabright/Twin Lakes with state beach lifeguards. DroneML did very well and found all the rips the lifeguard found (except for structural rips next to the jetty since the model has not been trained with that type of data). Also recruited collaborators at San Diego / Scripps through the Sea Grant project to help test DroneML.
- Provided shoreline change product to the USACE for review and feedback.

Obj. 3.4) Operationalization of approach and resultant output: 10% Complete

- Nothing to report

Goal 4) Package image products into geographically and thematically transferable decision-support tools.

Obj 4.1) Develop, validate and operationalize a 'situational monitoring and reporting' tool: 65% Complete

- Rip locations via bounding boxes as detected by Faster RCNN is already in place which should allow production of binary yes/no rip presence. We will evaluate running ripviz on a site first before producing rip shape as detected by hybrid detector.
- Developed database, beta webpage login, and notification pages for use with the planned Notification Tool.

Box 26. What opportunities for training and professional development has the project provided?

- UNCW Graduate student Jeremy Braun presented his work at three conferences (AGU Fall Meeting, Young Coastal Scientists and Engineers of the Americas, and Sea Grant's NC Coastal Conference). Undergraduate student, Drew Davey, also presented his work on vessel traffic at the Young Coastal Scientists and Engineers of the Americas conference.

Box 27. How were the results disseminated to communities of interest?

- Presented WebCOOS at Sea Grant’s NC Coastal Conference.
- Provided shoreline change product to the engineers for the Town of Oak Island for review and feedback.
- Working with Rosemount community leaders to develop educational material.
- Developed and published two news stories: [Camera Footage of Marine Mammal Releases Available to View on WebCOOS](#) and [Strength in Numbers: The Power of Joining Forces](#).

Box 28. What do you plan to do during the next reporting period to accomplish the goals and objectives?

Objective 1.1) Identify and engage Tier 1 and 2 users

- The Walton lighthouse webcam request got approved and the webcam was installed. Work will continue to troubleshoot some technical issues with frame rate.
- Continue engagement with Tier 2 stakeholders for object detection and flooding, and establish communication with stakeholders interested in shoreline change and rip current products.
- Finalize installation of Wrightsville Beach Coast Guard station webcam and Florida homeowner webcam.
- Continue to engage with CIRN at their annual meeting in May.

Objective 2.1) Engage with identified cameras of opportunity

- Reach out to two researchers that indicated interest when seeing Jeremy Braun’s presentation at the AGU meeting. They currently operate webcams.
- Continue discussions with partners to include webcam streams from Flagler Beach, FL and Horace Caldwell Pier near Port Aransas, TX.
- The team is exploring how to bring a collaboration to fruition work with Earthcam, a large webcam installation and hosting company. A number of preliminary conversations have taken place to date, with upcoming meetings focused on the technical implementation of the partnership.

Objective 2.2) Develop interactive web portal to access live webcam feeds, historical archive footage, and webcam products

- Maintain WebCOOS portal and make requested updates and changes.

Objective 2.3) Standardize webcam imagery and metadata documentation and delivery

- Finalize all documentation on the entire WebCOOS system.

Objective 2.4) Develop end-to-end data management workflow integration

- Maintain data management workflow.
- Finalize data product management with science PIs.

Obj 2.5) Integrate quality assurance and quality control (QA/QC) mechanisms

- Nothing to report.

Objective 3.1) Further develop detection algorithms

- Submitted FRCNN code customized for Currituck Hampton Inn to Axiom. Lack of GPU hampering our schedule for adding sediment rip data for training our FRCNN and RipViz (heavier weight models). Lightweight model using MobileNetV2 is fine.
- Test algorithms in an operational system, identify issues, and correct them.

Objective 3.2) Develop operational prototype products

- Provide shoreline change and beach erosion code to Axiom for testing.

Objective 4.1) Develop, validate and operationalize a ‘situational monitoring and reporting’ tool

- Continue to develop database, beta webpage login, and notification pages for use with the planned Notification Tool. Integrate rip current products and notifications.
- Engage with UofSC developers to integrate shoreline products.

Products: Comments are required in Boxes 29 – 32 are required the first initial progress report. Subsequent reports will be prepopulated with the information from the previous report and have a limit of 4,000 characters. If the comment is blank, the “Nothing to Report” checkbox must be checked.

Box 29. Publications, conferences papers and presentations

- Akila de Silva, Mona Zhao, Donald Stewart, Fahim Hasan Khan, Gregory Dusek, James Davis, and Alex Pang, “RipViz: Finding Rip Currents by Learning Pathline Behavior”, accepted to IEEE Transactions on Visualization and Computer Graphics, 2023. Preprint at this arxiv link: <http://arxiv.org/abs/2302.12983>.
- Graduate student Jeremy Braun presented his work at three conferences (AGU Fall Meeting, Young Coastal Scientists and Engineers of the Americas, and Sea Grant’s NC Coastal Conference). Undergraduate student, Drew Davey, also presented his work on vessel traffic at the Young Coastal Scientists and Engineers of the Americas conference.
- Long presented an overview of WebCOOS at the Sea Grant’s NC Coastal Conference.

Box 30. Technologies or techniques

- Nothing to report

Box 31. Inventions, patent applications, and/or licenses

- Nothing to report

Box 32. Other products

- Combining the works from DroneML and RipSnap to create RipFinder (phone based rip current detector). Once a rip is spotted by DroneML, circle around it and take video from different/lower elevation. RipFinder can double as a citizen science app also.
- Developed database and beta webpage login and notification pages for use with system alerts.

Participants & Other Collaborating Organizations – Note that all comments boxes are required and the first report will always be blank. For comments boxes 33, 35 & 36 subsequent reports will be pre-populated with the information from the previous report. Comments boxes have a limit of 4,000 characters. For comments boxes 34 – 36, if the comment box is blank, the “Nothing to Report” checkbox must be checked.

Box 33. What individuals have worked on this project?

- From UCSC, Issei Mori and Donald Stewart graduated. Mona Zhao is about to graduate. Recruited a couple of MS students (Omkar Patil and Nicholas Tee) to work with Akila on extending pathline sequence analysis for vortex detection and quantifying uncertainty. James Garrett didn't work out.

PI: Debra Hernandez, SECOORA Executive Director

Lead Science PI: Dwayne Porter, Univ. SC

UofSC Graduate Student: Louisa Schandera

Senior Software Developer: Jeremy Cothran

Co-PI: Joseph Long, Univ. NC Wilmington

UNC Undergraduate Student: Kelsea Edwing, Summer Banning, and Drew Davey

UNCW Graduate Student: Jeremy Braun

Co-PI: Alex Pang, Univ. California Santa Cruz

UCSC Graduate Students: Akila de Silva, Fahim Khan, Omkar Patil, and Nicholas Tee

UCSC Undergraduate Student: Mona Zhao

Co-PI: Kyle Wilcox, Axiom Data Science

Axiom Project Manager: Lauren Showalter

Box 34. Has there been a change in the active other support of the Project Director/Project Investigator(s) or senior/key personnel since the reporting period?

No

Box 35. What other organizations have been involved as partners?

- O'neill Sea Odyssey and Santa Cruz Harbor office were both very helpful in getting us setup at the Walton lighthouse. The lifeguards at the California State Park beaches in Santa Cruz were very helpful in helping us validate DroneML.

Box 36. Have other collaborators or contracts been involved?

- The team is exploring how to bring a collaboration to fruition work with Earthcam, a large webcam installation and hosting company. A number of preliminary conversations have taken place to date, with upcoming meetings focused on the technical implementation of the partnership.

Impact – Note that all comments boxes are required and the first report will always be blank. For comments boxes 37 - 43 subsequent reports will be pre-populated with the information from the previous report. Comments boxes have a limit of 4,000 characters. For comments boxes 37 - 43, if the comment box is blank, the “Nothing to Report” checkbox must be checked. For comment box 44, only the percent is required (even if it is a zero), the explanation is not required.

Box 37. What was the impact on the development at the principal discipline(s) of the project?

Box 38. What was the impact on other disciplines?

- We are exploring applicability of pathline sequence analysis for detecting other types of flow features e.g. vortex boundaries.

Box 39. What was the impact on the development of human resources?

- UCSC had two students from the project graduate, and a new hire that did not work out. They are currently looking for new students.

Box 40. What was the impact on teaching and educational experiences?

- With the offshoot project on RipFinder, we’re hoping that the phone app will also help educate users about rip currents.
- We have engaged graduate students from the UofSC, the College of Charleston and the Medical University of South Carolina in community engagement activities, and utilized aspects of WebCOOS in curriculum development for two graduate courses at USC: ENHS 775 - Resource Management and Environmental Risk Assessment and PUBH 700 - Public Health Leadership.

Box 41. What was the impact on physical institutional and information resources that form infrastructure?

Box 42. What was the impact on technology transfer?

Box 43. What was the impact on society beyond science and technology?

- Community awareness and decision making
- Ability to access live webcam footage of various locations for decision making

Box 44. What percentage of the award is budget was spent on foreign countries?

Enter Percent: 0%

Changes/Problems – Note that all comment boxes are required fields and have a limit of 4,000 characters. If the comment box is blank, the “Nothing to Report” checkbox must be checked.

Box 45. Changes in approach and reason for change

Box 46. Actual or anticipated problems or delays and actions or plans to resolve them

- The hurdle at the USCG office for the Walton lighthouse was finally cleared.
- The team has decided to request a no cost extension to further refine the products and engage more users in review of this tool. The one-year, no-cost extension will allow SECOORA to utilize remaining funds to fully realize the potential of the webcams we have installed. The science PIs will continue to engage students in developing and testing algorithms. The University of South Carolina team will refine a “notification” tool and conduct usability testing with communities. Axiom will continue to support integration of new cameras and PI code.

Box 47. Changes that had a significant impact on expenditures

- With the no-cost extension, we proposed some slight shifts in budgets. A majority of the funding would move from one of the contracts in "Other" to another contract in "Other." Specifically, we had funds for a "TBD Private sector camera operator" but our data management company has ended up providing this capacity, so we will move funds from the TBD line to our data manager (~\$58k). Again, both of these are under the "Other" budget item. The other shift would be moving funds from "Travel" to "Other" to provide some supplemental funding to one of our contractors who is developing tools and doing end user engagement (~\$25k). Due to COVID, we did not need as much travel funding as was originally proposed.

Box 48. Significant changes in use or care of human subjects, vertebrate animals, biohazards, and/or select agents

Not Applicable.

Box 49. Change of primary performance site location from that originally proposed