

**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**

- Engaged with the NWS-Wilmington and USCG at Wrightsville Beach to add a camera overlooking Masonboro Inlet to support operations (boating conditions, vessel traffic, etc). Internet and camera installation currently being scheduled.
- Engaged with a homeowner on the FL Atlantic coast for a new camera location. Camera installation currently being scheduled.
- As part of effort to get a webcam situated at the Walton Lighthouse in Santa Cruz, presented ML and flow based rip current detection algorithms to potential Tiers 1 and 2 users (USCG San Francisco, California State Parks Santa Cruz, Harbor Master Santa Cruz, Fire Department/Lifeguarding Santa Cruz, O’neill Sea Odyssey Santa Cruz).
- Continued monthly team meetings and began planning for an in person team meeting in Charleston with Tier 1 users in October 2022.

**Obj 1.2) Develop, assess and disseminate stakeholder appropriate outreach and education materials**

- Ran roughly once/week drone flights to collect additional rip data – mostly sediment rips, but also a couple of structural rips. Added sediment rip detection to RipSnap. Mobile rip version now detects both bathymetry and sediment rips (from height). Added this capability to droneML which allows automated drone control to collect ‘steady’ (subject to wind, gyro, ..) video of detected rip. This capability will help other drone operators help collect rip data even if they’re not rip experts.
- Worked with the Charleston Community Research to Action Board (CCRAB), Lowcountry Alliance for Model Communities (LAMC) and the Rosemont Neighborhood Council to identify signage needs for community-based monitoring assets, and to identify situational reporting needs.
- Finalized an [outreach packet](#) to share with interested partners.

**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.**

- Identified and engaged with numerous Tier 2 users:
  - South Carolina Maritime Museum for monitoring Sampit River water levels and documenting river usage
  - Charleston Community Research to Action Board for data management and situational reporting needs
  - City of Charleston for flood monitoring
  - Town of Folly Beach for beach usage reporting
  - Charleston County Parks and Recreation Commission for monitoring beach parking lot usage
  - Berkeley-Charleston-Dorchester Council of Governments for monitoring incoming / outgoing beach traffic
  - Rosemont Neighborhood Council for monitoring and documenting flooding conditions
- Continuing to engage and develop the citizen science-based community monitoring program with the Rosemont Neighborhood Council and Rosemont community members in Charleston County to provide guidance and review and comment on developed products.

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

**Obj 2.1) Select camera providers and maintain webcams**

- Working with Tier 2 users, the following monitoring assets have been installed:
  - Snapshot cameras - raspberry pi computer+camera module
  - [Rosemont Peonie Street](#) - solar + verizon hotspot device/cell plan
  - [Rosemont Peace Street](#) - homeowner power + wifi
  - [Folly Beach 6th Avenue](#) - solar + homeowner wifi
  - Isle of Palms - 2 pi+cameras used to detect/determine car parking entrance/exit/total counts - no image/video provided or stored, only counts
- Working with Tier 1 users, the following cameras were installed:
  - Two at the UNCW Center for Marine Science Dock
  - Two at Jennette’s Pier

- Currently working with the Miami WFO and a hotel to install a new camera focused on rip currents for lifeguard operations.
- Moved all existing WEBCAT assets over to the newly developed WebCOOS system.
- Ingested and maintained newly installed cameras.
- Ingested several non-SECOORA region cameras to begin display of national capabilities, including the Sheraton, Waikiki, HI and the The Marine Mammal Center at Point Reyes National Seashore.
- Developed initial budgeting and technology plan for scaling to a national camera network.

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

- WebCOOS website updated and launched to public url <https://webcoos.org>. New features include:
  - Overall site updates based on feedback from the WebCOOS team
  - Updated front page with news and interactive camera map
  - Implementation of individual camera pages
  - Added support for filtering out portions of a camera image
  - Camera table
  - Updated help text
  - Date picker for individual cameras
  - Availability of various video products (stills, clips, live, etc.) on each camera page
- A draft Rosemont/CCRAB community sensor page has been established (<http://saludasys.org/ccrab/>) to highlight webcam products. Initial draft webpage includes:
  - the WeCOOS framed content from the Peonie and Peace Street cameras
  - the co-located air monitors and rain gauge measurements and graph at Peonie with heavy rainfall dates indicating likely flooding shown in camera shots.

**Obj 2.3) Standardize webcam imagery and metadata documentation and delivery**

- Continued iteration of schema-based camera metadata profile; Display of standard image products: Live video, 10 minute clips, and stills available on individual camera pages.

**Obj 2.4) Develop end-to-end data management workflow integration**

- 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 camera 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 camera systems.
- Tested ingestion process for additional data products including code and georectified imagery.

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

- Continued data collection for rips as well as development for hybrid rip detector. The latter aims to detect rip based on what's normal ocean flow vs anomalous (rip) flow behavior. Model is

trained to ignore what is considered normal flow patterns e.g. incoming waves, cloud movements, foreground movements due to wind, etc. Test suite currently from fairly secluded beaches. Will need to also add people (swimmers, surfers, joggers, etc), boat traffic, etc. from generating false positives.

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

**Obj 3.1 Further develop detection algorithms**

- Completed object (person,vehicle,bird) detection algorithm and it is working as expected within given limits and accuracy.
- Completed python-based shoreline detection algorithms. Tested on both Oak Island,NC and Corolla, NC video archives.
- Sediment rip detection was integrated into RipSnap and DroneML. Continue to collect data for other rips (structural, foamy signature).

**Obj 3.2) Develop operational prototype products**

- Need help with testing/validating RipSnap/DroneML at other locations. RipSnap has iOS and android versions. DroneML controls use DJI API and was tested on DJI Phantom 4 pro V2.
- Working with CCRAB and Rosemont Neighborhood Council on community needs for situational reporting tool.

**Obj 3.3) Validation of prototype**

- Georectified Oak Island, NC cameras to validate shoreline change products from standard webcams.

**Obj. 3.4) Operationalization of approach and resultant output**

**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:**

- Planning on different types of image products for rips: (a) rip locations via bounding boxes as detected by Faster RCNN, (b) rip shape as detected by hybrid detector, (c) binary yes/no rip presence. These could in turn be used to generate customized alerts for various users. These can be filtered per camera, per view, for a time range.

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

- UNCW added 1 undergraduate (Drew Davey) to implement/test tracking of vessels using computer vision techniques.
- UCSC Mona is helping out with various tasks to aid rip detection efforts e.g. sky, beach, ocean segmentations and looking into ML approach for shoreline detection. Donnie completed his MS and was very helpful with drone field experiments and data labeling help. We added another ML student (James Garrett) to help with integrating some work that could be turned into part of decision support tools. He is tasked with detecting people in rips, and distinguishing whether

person is a swimmer or a surfer. He's using COCO set for people and "surfboard" (which includes a variety e.g. body board, SUP, windsurf, kitesurf, ..) for detection, and adding basic proximity to decide if person is surfer or not.

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

- Published [Flow-Based Rip Current Detection and Visualization](#).

**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**

- Eliminated Santa Cruz Wharf as a potential site since the rips there are generally very weak. Awaiting approval from USCG on installing a webcam at the Walton Lighthouse which offers ideal views of both Seabright and Twin Lakes beaches. It also has a view of the harbor entrance and could be used for monitoring boat traffic there.
- Continued engagement with Tier 2 users, underserved communities, and build upon the Rosemont initiative to expand to other underserved communities.

**Objective 2.1) Engage with identified cameras of opportunity**

- Update on the UCSC webcam is that we are still waiting for USCG approval. Will follow up in mid-September which is when they expect a decision might be made.

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

- Developed data catalog and API for accessing cameras.
- Developed data catalog and API for imagery and video data access.

**Objective 2.3) Standardize webcam imagery and metadata documentation and delivery**

- Developed an approach to handle panning cameras and ensure different views are cataloged for easy access.
- Identified specialized privacy needs for raw imagery and address via raw imagery processing.

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

- Set up and documented product ingest pathways.
- Developed data catalog of products.
- Develop API for product access.

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

**Objective 3.1) Further develop detection algorithms**

- Test Faster RCNN and Hybrid detectors using Walton Lighthouse webcam if/when that comes online.

- Isle of Palms - parking/vehicle counts/activity - deepsort for object tracking and further coding to help with erroneous id switching for the same object.

**Objective 3.2) Develop operational prototype products**

- For Rosemont Peonie and Peace street cameras, changing to [Reolink E1 outdoor camera](#) which includes pan/tilt functions to gather wider coverage area shots during flooding - the raspberry pi is still useful with regards to collecting other sensor information (rain gauge or flood detection) and acting as a go-between/proxy for remote device access without having to work through the providers equipment or router for access. Also working on minio upload to axiom/webcoos storage.

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

**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**

- [Flow-Based Rip Current Detection and Visualization](#)

**Box 30. Technologies or techniques**

- Testing of various size solar panels and rechargeable battery sizes against snapshot and video stream camera devices to better determine the sizing of solar/battery combinations to meet equipment power needs. Learning and developing scripts to remotely access and control camera pan/tilt/zoom or other options via [ONVIF Profile S protocol](#).

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

**Box 32. Other products**

- RipSnap and DroneML has lightweight version of rip detection (bathymetry and sediment rips) using MobileNet V2.

**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?**

PI: Debra Hernandez, SECOORA Executive Director, [Megan Trembl, Project Coordinator](#)

Lead Science PI: Dwayne Porter, Univ. SC

UofSC Graduate Student/Coordinator: 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, Donnie Stewart, and James Garrett

UCSC Undergraduate Student: Mona Zhao and Issei Mori

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?**

Megan Trembl has re-joined SECOORA and is serving as the project coordinator for the overall project.

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

**Box 36. Have other collaborators or contracts been involved?**

- Dr. Derek Grimes, UNCW, has started to collaborate on vessel tracking initiative in order to relate vessels observed to boat wakes generated
  - NIEHS Center of Excellence for Oceans and Human Health and Climate Change Interactions
  - EPA EJ STRONG
  - Rosemont Neighborhood Council
  - SC Beach Advocates
  - Charleston Community Research to Action Board
  - Lowcountry Alliance for Model Communities
  - SC Maritime Museum
  - NI / WB National Estuarine Research Reserve

**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?**

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

- UCSC:



- Undergraduate Issei Mori graduated and is continuing graduate studies at UCSD; undergraduate Mona Zhao is learning about segmentation and ML for shoreline extraction.
- MS student Donnie Steward helped with DroneML coding and data labeling and has since graduated. MS student James Garrett is learning about object detectors and integrating multiple detectors (people, surfboard, rips).
- Phd student Akila de Silva is working on high accuracy rip detectors, while Phd student Fahim Khan is working on lightweight mobile versions, and incorporating these as examples of citizen science projects enabled by his platform.

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

- UCSC includes the rip current detection project in undergraduate and graduate classes in data visualization. Students learn about how techniques they learn in class have practical applications. Was also able to recruit students from such classes to contribute to the project.

**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?**

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

Enter Percent: 0%

Enter Percent:

Enter Explanation:

**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**

- There was a change in leadership at the local USCG office. We are awaiting a decision from USCG which they indicated might take “a couple of months”. Hosting for the land-based internet service through O’neill Sea Odyssey will kick in as soon as we get OK from USCG.

**Box 47. Changes that had a significant impact on expenditures**

**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**