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 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: 33% Complete
  ● Defined additional tier 2 end-users; City of Isle of Palms, Beach Reach,Currituck County, and the LowCountry Alliance for Model Communities
Obj 1.2) Develop, assess and disseminate stakeholder appropriate outreach and education materials: 33% Complete
  ● Developing educational material and instructions for AI object detection and camera placement
Objective 1.3) Nothing to Report 0% Complete.

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

Obj 2.1) Select camera providers and maintain webcams: 33% Complete
- Confirmed 8 cameras to be integrated
- Identified companies who could provide hardware, maintenance, and networking support
- Identified Wilmington NC Ocean Rescue as a maintainer and operator of a pilot docking station to house smart phones.

Obj 2.2) Develop interactive web portal to access live webcam feeds, historical archive footage, and webcam products: 33% Complete
- Axiom established links to webcams for data ingestion and display. Established software engineering and cyberinfrastructure support for the development of operational data management and analysis systems.
- Created a WebCOOS-branded data portal: shows real-time camera data feeds and archives camera products

Obj 2.3) Standardize webcam imagery and metadata documentation and delivery: 33% Complete
- Developed standard metadata schema for video data by leveraging the revised IOOS metadata profile.
- Developed a Python script to generate four standard image products from the webcam videos to support various use case scenarios for Tier 1 users

Obj 2.4) Develop end-to-end data management workflow integration: 17% Complete
- Created an ingestion process for web camera data feeds via direct camera communication.

Obj. 2.5) Nothing to Report

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

Obj 3.1 Further develop detection algorithms: 40% Complete
- Developed a new Python-based algorithm for webcam shoreline detection
- Updated the workflow for shoreline detection from cell imagery (added an estimate for wave runup to the detection using offshore SECOORA wave buoy assets (CORMP))
- UCSC graduate students worked on: improving detection of elongated objects, investigating a multi-branch ML model and prediction combinations, trained lightweight ML model for smartphones, developed an initial implementation of supporting infrastructure to collect observations from mobile devices, and supported simulated "drone" flight over google map imagery to detect rip currents.

Obj 3.2) Develop operational prototype products: 33% complete
- Defined citizen-science project tasks for manual image annotation.

- Tested processing object count to database summary records, graphs, and analysis for further discussion.
- Developed a python package to automatically 1) download webcam videos from Axiom ftp, 2) compute standard image products, 3) determine video orientation , 4) undistort image, 5) identify the shoreline, and 6) compare shoreline position to the base of the sand dune or infrastructure to identify potential risk. The program has a basic GUI for Tier 2 stakeholders use or can be run without the GUI for Tier 1 users.
- Continued development smartphone app for rip detection using a lightweight ML model and smartphone apps for other potential citizen science apps using the developing authoring infrastructure

Obj 3.3) Validation of prototype
- Tested the prototype programs for shoreline extraction on three existing webcams.

Obj. 3.4) Operationalization of approach and resultant output
- Conducted accuracy comparisons for rip detection alternatives.

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: 33% complete
Continued development and pivoting of "Situational Monitoring and Reporting Tool" prototype based on end-user feedback.

Box 26. What opportunities for training and professional development has the project provided?
Training for a UNCW graduate student in python coding, video remote sensing, and coastal hazard research studies. Support of one undergraduate student who maintains and processes shorelines from all still images collected through a citizen-science project using cell phone-based imagery.

The project has provided opportunities for students from Phd, MS, undergraduate as well as high school students to participate. This spring and summer, 2 high school students were involved with data collection for structural rips, 1 undergraduate student was involved with drone API investigation for app development, 1 MS student submitted a revised work for journal publication, and 2 Phd students worked on ML and citizen science aspects relevant to rip current research.

Box 27. How were the results disseminated to communities of interest?
Members of the project team, from the University of California Santa Cruz and NOAA, presented a SECOORA webinar on June 22nd to discuss some of the project results

and impacts thus far entitled: Applying technology to improve our ability to forecast, observe and detect rip currents

A UCSC undergrad student submitted revised work on flow-based rip detection to IEEE ACCESS.

Tier 1 project partners were invited to a WebCOOS team project presentation.

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
Continue identifying Tier 2 end-users
Continue engagement with defined Tier 2 end-users for camera placement and product developments based on needs.
Collect feedback from Tier 1/2 users on algorithms for video access, standard image products, and shoreline detection.

Objective 2.1) Engage with identified cameras of opportunity
Identify additional sites in Florida for potential new camera installations
Continue engagement with identified operators of cameras of opportunity
Expand WebCOOS integration points and 'help' documentation to support additional residential camera hosts and historical footage

Objective 2.2) Develop interactive web portal to access live webcam feeds, historical archive footage, and webcam products
Incorporate feedback to improve existing web portal and improve ability to showcase existing resources on the website.

Objective 2.3) Standardize webcam imagery and metadata documentation and delivery
Test code developed for standard image products at remaining WebCAT/WebCOOS sites.
Release documented camera ingestion system to the community

Objective 2.4) Develop end-to-end data management workflow integration
Improve computational efficiency of camera ingestion using GPU resources for scalability. Develop customized camera configurations: image save interval, resizing, timestamps, transformation, optimize, and provide webhook save.

Obj 2.5) Integrate quality assurance and quality control (QA/QC) mechanisms
 Nothing to report.

Objective 3.1) Further develop detection algorithms
Test code developed for shoreline extraction at remaining WebCAT/WebCOOS sites. Continue working on both accuracy improvements and robustness for different types of rips, as well as platforms beyond webcams. Effort will mainly be algorithm development and experimentation.

Objective 3.2) Develop operational prototype products
Refine operational prototype products based on results from planned pilot study being conducted in late summer.

Objective 4.1) Develop, validate and operationalize a 'situational monitoring and reporting' tool
Discuss opportunities to build shoreline extraction products into the situational awareness 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
WebCOOS overview presented at the 2021 Regional Collaboration Workshop hosted by NOAA on Artificial Intelligence**.**

Issei Mori, Akila de Silva, Gregory Dusek, James Davis, and Alex Pang, ``Flow-based Rip Current Visualization'', submitted to IEEE ACCESS.

Fahim Hasan Khan, Akila de Silva, James Davis, Gregory Dusek, and Alex Pang, ``Authoring Platform for Mobile Citizen Science Apps with Client-side ML'', accepted for publication in CSCW'21.

Box 30. Technologies or techniques

Box 31. Inventions, patent applications, and/or licenses
Nothing to Report.

Box 32. Other products

Aiming to develop a smartphone app beta version for rip detection.

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
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
UNCW Graduate Student: Jeremy Braun
Co-PI: Alex Pang, Univ. California Santa Cruz
UCSC Graduate Students: Akila de Silva 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?

No

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

Box 36. Have other collaborators or contracts been involved?

Individuals from the City of Isle of Palms, LowCountry Alliance for Model Communities (LAMC), BCDCOG (Berkeley-Charleston-Dorchester Council of Governments) Beach Reach, and Currituck County are collaborating with the WebCOOS project.

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?
Mentoring and development of computational skills for undergraduate and graduate-level researchers.

Box 40. What was the impact on teaching and educational experiences?
To date, UCSC, has engaged 7 high school students through our summer internship program (SIP) on this project; one undergraduate student who worked on this project has graduated and will be continuing on to graduate school; one Phd student has advanced to candidacy.

Box 41. What was the impact on physical institutional and information resources that form infrastructure?
Nothing to report.

Box 42. What was the impact on technology transfer?
Nothing to Report.

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%

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
Nothing to Report.

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

UCSC: Collection of training data is time consuming and error prone. We are looking at how to deal with label noise when training our ML model e.g. by explicitly accounting for the confidence of a label in individual training data item.

Box 47. Changes that had a significant impact on expenditures
Nothing to report

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
Nothing to Report.

Project Outcomes – Note that the comment box is a required field and has a limit of 4,000 characters
Box 50. What were the outcomes of the award?
        Nothing to Report.