

**PAGAN, UPRM**  
**DHS Coastal Resilience Center**  
**Education Project:**  
**Annual Project Performance Report**

Covers reporting period January 1, 2016 – June 30, 2016

1. **Project Title:** Education for Improving Resiliency of Coastal Infrastructure
2. **Principal Investigator / Institution:** Ismael Pagán-Trinidad (PI), Ricardo R. López (Co-PI), University of Puerto Rico at Mayagüez
3. **Other Education Participants/Partners:** ERDC-US Army Corps of Engineers; Puerto Rico (PR) Emergency Management Agency; FEMA, PR Department of Natural and Environmental Resources (Coastal Management Program); Association of Professional Engineers of PR, UPRM partners (Marine Science Department, Sea Grant Program, CariCOOS NOAA project); NOAA (National Weather Service); PR Climate Change Council (PRCCC)

4. **Short Project Description:**

This project will help educate the community by transferring state of practice knowledge on resiliency of coastal infrastructure (RCI) to stakeholders (students, faculty, professionals, first responders, and work force) through formal (curriculum, internships, student projects) and informal (workshops, seminars, lectures, short courses, webinars) learning experiences. It will serve as a vehicle to engage the community as a whole to understand and learn its members' roles and responsibilities in providing resilient coastal infrastructure systems. The project will help the community understand better various stages in coastal infrastructure hazard prevention, preparedness, response, recovery, and mitigation. It will also help create pipelines of students and professionals into RCI careers and practice.

5. **Abstract:**

The goal of this project is to develop and offer formal and informal education through courses, workshops, seminars, lectures, and other educational means to advance knowledge on the state of practice on RCI (built and natural). This initiative aims at creating a **Certificate in RCI**. The focus of the project is to provide students and faculty, professionals and homeland security personnel, and affected citizens with capabilities to assess the effects of natural hazards on coastal infrastructure, the conditions of existing structures, and rehabilitation alternatives to mitigate future damage and potential risks. New courses and existing course revisions will be evaluated in Civil Engineering and related disciplines dealing with estimates of causes and effects of coastal flooding, storm surge, ocean waves, tsunami loads, earthquake effects, and

strong winds on infrastructure. Experts will be invited as lecturers. State of practice will be a priority. Results of recent research work will be incorporated. Being a small and fully developed island, Puerto Rico offers the ideal setting to assess lessons learned of the effect of natural hazards on built and natural infrastructure including housing, commercial, industrial, institutional, transportation, communication systems, and others. This program will facilitate participation in internships at CRC partner universities, government agencies, and industry dealing with coastal hazards. As a Minority Serving Institution (MSI) with a high female enrollment (near 1/3 in Civil Engineering) it is also our goal to provide an up to date level of RCI competency in the Hispanic community.

**6. End users:**

End Users*	Role of Participation in the Project
<p><u>Students:</u></p>	<p>Trainee; Interns; Undergrad/grad research experiences on RCI topics</p> <ul style="list-style-type: none"> <li>• Kevin Cueto, MSCE (Struct) Oregon State Univ., Intern</li> <li>• Diego Delgado, BSCE, Oregon State Univ., Intern</li> <li>• Felix Santiago, MSCE (Env), Univ. of Central Florida, Intern</li> <li>• Efrain Ramos, MSCE (Env), ERDC-US Army CoE, Intern</li> <li>• Jaime Calzada, PHD (Marine Sc.), ERDC-US Army CoE, Intern</li> <li>• Gabriela Salgado, MSCE(Environ), ERDC-US Army CoE, Intern</li> <li>• Jesús Otero, BSCE, ERDC-US Army CoE, Intern</li> <li>• Stefanía Quiñones, MSMS, ERDC-US Army CoE, Intern</li> <li>• Gabriela Buono, BSCE, UPRM, Undergraduate Research</li> <li>• Ángel Alicea, PhD, UPRM, Research Assistant in the project</li> </ul>
<p><u>Faculty</u></p>	<p>Trainers/Teachers in courses, seminars, workshops; CRI leaders; Project Advisors; Course content evaluators;</p> <ul style="list-style-type: none"> <li>• A.Saffar-Coastal Resilient Structures (3 credits)</li> <li>• A.Morales- Introduction to Marine Geomechanics (3 credits)</li> <li>• R.López &amp; I.Pagán-Natural Hazards in Coastal Zones (3 credits)</li> <li>• R.Ramos Geotechnical Analysis of Coastal Structures (1 credit)</li> <li>• J.Muñoz-Remote Sensing in Coastal Erosion</li> <li>• L.Aponte-Wind Engineering for Coastal Applications</li> </ul>
<p><u>Professionals</u></p>	<p>Trainee; Trainers; Advisors; Providers of lessons learned; Survey responders for priority needs</p> <ul style="list-style-type: none"> <li>• 26 trainees and surveyed individuals, 3 trainers (Matt Pendleton, Billy Brooks, Doug Marcy from NOAA) @ Coastal Flood Workshop, June 6 and 7, 2016, Dept. of Civil/Surveying Dept. (in partnership with UPRM Sea Grant Program)</li> <li>• 7 mentors and 5 mentees at Summer Research Internship program at Engineer Research and Development Center of the US Army Corp of Engineers</li> <li>• 4 mentors and 3 mentees at OSU, UCF, and LSU SUMREX</li> </ul> <p>Other professionals participated at these activities:</p>

	<ul style="list-style-type: none"> <li>Over 60 people participated at CARICOOS Annual Conference at San Juan PR where the CRC Center project was formally presented and advertised. First and other responders participated and exchange views and ideas. All were surveyed. Survey results are pending.</li> </ul>
Researchers from CRC	<p>Advisors on course/seminar/workshop contents (breadth and depth); providers of internship opportunities; recruiters of students for graduate school; Trainers/lecturers; advisors</p> <ul style="list-style-type: none"> <li>Dr. Dan Cox, Oregon State University-Mentor Internship</li> <li>Dr. John van de Lindt, Colorado State University, Mentor, Internship</li> <li>Dr. Stephen Medeiros, University of Central Florida, Mentor, Internship</li> <li>Dr. Scott Hagen, Louisiana State University, Mentor, Internship</li> <li>Dr. Robert Whalin, Jackson State University, Article coauthors and project Advisor</li> </ul>
First responders (HLS Partners)	<p>Trainee; Trainers/Lecturers; Survey responders of priority needs</p> <ul style="list-style-type: none"> <li>18/26 participants in the Coastal Inundation Workshop by NOAA identified or related to first responders. All 26 were surveyed.</li> <li>30 participants, including first and other responders, participated at Hurriplan Workshop sponsored by PR Sea Grant Program, one of our UPRM partners, and presented by National Disaster Preparedness Training Center (NDPTC) and the University of Hawaii Surveyed collaborated by PR Sea Grant program. Project PI and Co-PI participated in the training and had the opportunity to announce and advertise the CRC project.</li> <li>Over 60 people participated at CARICOOS Annual Conference at San Juan PR where the CRC Center project was formally presented and advertised. First and other responders participated and exchange views and ideas. All were surveyed. Survey results are pending.</li> </ul>
General Responders	<p><b>Trainee; Trainers; Survey responders on priority needs;</b></p> <ul style="list-style-type: none"> <li>See previous section, included in the discussion.</li> </ul>
UPRM Partners	<p><b>Leverage; Support; Trainers; Collaboration</b></p> <ul style="list-style-type: none"> <li>Ruperto Chaparro, Sea Grant Director</li> <li>Julio Morel, CariCOOS Director</li> <li>Aurelio Mercado, Marine Sciences Researcher</li> <li>Miguel Canals, Ocean Engineering Research Centre Director and Researcher</li> <li>Sylvia Rodríguez, Materials Science and Engineering Researcher</li> <li>Cecilio Ortiz, Social Science Research Center, Researcher</li> <li>David Sotomayor, Agricultural Science Researcher</li> <li>Raul Zapata, Assistant to Chancellor</li> <li>Various faculties</li> <li>Various technical personnel</li> </ul>
Government Executive and Legislative branches	<p>Leverage; Support; Advice</p> <ul style="list-style-type: none"> <li>PR Senate: Written and oral position hearing on behalf of Chancellor at the PR Senate Special Commission on Climate Change. Interviewed with legislators on climate change and its effects in coastal environments in PR and the Caribbean were discussed. Follow up on the initiative after the hearing was incorporated as part of the activities of the project.</li> </ul>

	<ul style="list-style-type: none"> <li>• Ernesto Diaz, Director of Coastal Management Zone, Dept. of Natural and Environmental Resources and Director of the PR Climate Change Council.</li> <li>• Coastal and Hydraulics Laboratory, ERDC – US Army CoE</li> </ul>
--	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

## 7. Explanation of Changes:

No changes from initially approved work plan.

## 8. Unanticipated Problems:

The unanticipated challenges have been mostly difficulties in coordination of meetings with intended end users. These have been resolved. The meetings occurred in July and the several seminars and conferences are being scheduled in coordination with partners.

## 9. Project Outcomes:

- **Students: Training /Education through curriculum research and learning**
  - Formal undergraduate and graduate research work experience (experimentation, modeling, simulation, programming, and analysis)
  - Improve communications skills (oral, written, graphical, media) on RCI topics and literature
  - Provide knowledge and tools on coastal hazards and its impact on coastal infrastructure
  - Attract and motivate candidates into HS career with emphasis in RCI
  - Provide access to state of the arts and practice in RCI
  - Provide access to experts with RCI expertise
  - Create a pipeline towards advance degrees or work force on RCI and DHS priority job opportunities
  - Develop maturity, confidence, satisfaction and expertise on new advances in RCI topics
  - Support work force through internships and summer jobs
- **Agencies: Trained, guided, and motivated work force**
  - Vision to new worldwide RCI challenges
  - Provide human resources for work force
  - Upgrade human capital capabilities
  - Trained professional with better capabilities to face new challenges in RCI
  - Increase institutional expertise
  - Provide continuing education on state of art and practice

- Facilitate institutional networking and collaboration
  - Consultant to help regular work forces and advisors
- **Constituents: Continuing education RCI and HS advancements**
- Provide state of practice resources and tools, for example literature, software (GIS), data bases (geospatial), guidelines, case studies, and examples that can be applied in their jobs.
  - Advance expertise and confidence which help in career development and better opportunities.
  - Orient and persuade potential professional to follow HS careers.
  - Provide networking opportunities to engage in team work consultation and collaboration.
  - Gain hands-on experience on new technologies.
  - Become educators for other professionals in resilience topics.
- **Faculty: Scholar professional development**
- Provide scope of opportunities on Coastal Infrastructure Research to create new knowledge.
  - Provide resources and expertise to be incorporated into formal curricula.
  - Expand opportunities to team building and collaboration with scholars in the resiliency of coastal infrastructure.
  - Advise on funding opportunities and funding agencies.
  - Create opportunity for publishing.
  - Expand the scope of expertise.
  - Expand, update and upgrade existing programs on RCI.

**10. Education Activity and Milestone Progress:**

**Education Activities and Milestones: Progress to Date**

<b>Reporting Period 1/1/2016 – 6/30/2016</b>			
<b>Education Activity</b>	<b>Proposed Completion Date</b>	<b>% Complete</b>	<b>Explanation of why activity / milestone was not reached, and when completion is expected</b>
Training: “Beyond Academia: Maximizing Research Impact” – UPRM R&D Center	Feb 2016	100	
Collaboration Agreements UPRM - Univ. of Hawaii NDPTC, and Sea Grant Program	Feb 2016	100	
Participated in workshop: PER-306 HURRIPLAN Resilient Building Design for Coastal Communities	March 2016	100	

Kick-off meetings to launch the program, gather constituents	March 2016	75	<p>Project development has taken place by participating in various separate meeting and activities with constituents. A strategic partners' group meeting is scheduled for August 2, 2016 to plan and program various joint activities and join initiatives within and outside the university.</p> <p>Preliminary activities confirmed the opportunity of developing Center partnership with other internal and external partners to align and strengthen effectiveness of Center activities.</p>
<p>Preliminary course design: UPRM faculty</p> <ul style="list-style-type: none"> <li>• Coastal Resilient Structures (3 credits)– Saffar</li> <li>• Introduction to Marine Geomechanics (3 credits)– Morales</li> <li>• Natural Hazards in Coastal Zones (3 credits) – López &amp; Pagán</li> <li>• Geotechnical Analysis of Coastal Structures (1 credit) – Ramos</li> <li>• Remote Sensing for Assessment of Coastal Erosion- Muñoz</li> <li>• Wind Engineering for Coastal Applications-Aponte</li> </ul>	June 2016	60 (average)	<p>Each initiative is at a different stage. Most of these formal and informal course designs by faculty were not foreseen at the beginning of the project. However, a group of faculty has been enthusiastic and motivated to be involved in course revisions and development. Although faculty are working by themselves and we cannot guarantee final faculty deployment of the proposed courses, interesting initiatives are under development at different stages at the present time. Preliminary concepts are well defined.</p>
UPRM Funding: Perspectives of Climate Change in the Caribbean – Dec 2016 Initial coordination by June; Conference by Dec 2016	June 2016	100	Progress on schedule
Allocate Students in Summer Internships: SUMREX, ERIP-ERDC, UPRM	June 2016	100	Allocated 10 students. Three with SUMREX and 6 in Center topics with ERDC, and 1 at UPRM
Planning short course	June 2016	75	Course scheduled for late September 2016/Early October
Identify, meet, and survey the HS constituents to establish CRI educational priorities	June 2016	80	Have met constituents individually. Gathered results of surveys conducted by Sea Grant, CariCOOS, Dept Natural Resources, and ourselves.
Offer first series of seminars and lectures on RCI	June 2016	100	First workshop was offered in June 2016 on Coastal Inundation in collaboration with NOAA and PR Sea Grant Program. Technical presentation was given at the CariCOOS
<b>Education Milestone</b>			

<p>Create the constituents network and identify educational priorities on RCI based on the constituents needs (Metric: No. of constituents participating; list of educational priorities)</p>	<p>June 2016</p>	<p>100</p>	<p>The constituents have been identified and individual meetings have been held. This is a continuous activity. A strategic group meeting is scheduled for August. A list of educational priorities is being compiled and it will serve as a guide for educational programming.</p>

11. **Transition Activity and Milestone Progress:**  
**Transition Activities and Milestones: Progress to Date**

Reporting Period 1/1/2016 – 6/30/2016			
<b>Transition Activity</b>	Proposed Completion Date	% Complete	Explanation of why activity / milestone was not reached, and when completion is expected
First Series of seminar and lectures	June 2016	100	First short course was offered. Seminars and courses are being scheduled for Fall 2016 and Spring 2017 semesters
<b>Transition Milestone</b>			
Reach and engage first class of students, professionals, and faculty on RCI education. (Metric: Number of participants; Contents learned)	June 2016	100	<p><b>26 participants, Three days of instructions and laboratory work on fundamentals, theory, modeling, and simulations of coastal inundation using GIS tools:</b> Taught by NOAA personnel at the Computer Aided Instruction and Research Laboratory in the Department of Civil Engineering and surveying at UPRM. The first short course was offered with a diverse audience including Municipal, State and Federal Government officials, Consultants, Community officials, Educators, students, and general public. Final Evaluation of the short course given. Participants were surveyed on their needs and priorities.</p> <p><b>Engaged 10 graduate and undergraduate students in summer research experiences at four different institutions.</b> Six of ten students were registered in formal undergraduate and graduate courses for three credit –hours at UPRM. These students developed formal proposals, progress reports, and a formal technical paper, and will present their findings orally at the end of the summer. They will also submit an abstract to a conference to participate in a Summer Research Internship Conference.</p>

			<p><b>Seven faculties motivated and engaged in formal and informal course/seminars design:</b> Faculties were invited, oriented and motivated to get engaged in RCI education and research activities.</p>
--	--	--	------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

## 12. Interactions with research projects:

- **SUMREX** opportunities were communicated by researchers from three institutions, of which two were able to complete the process. Oregon State University (Dr. Dan Cox and Dr. John van de Lindt – two opportunities), and University of Central Florida/Louisiana State University (Dr. Stephen Medeiros/Dr. Scott Hagen- one opportunity). These initiatives were coordinated with Researchers during CRC meetings. Advertisements were posted including all requirements at the university. Interested students presented their credentials and we evaluated if students qualified. Students who qualified were advised to apply and referred directly to Research PI's for their evaluation. Two students were admitted at OSU (working at the O.H. Hinsdale Wave Research Laboratory (HWRL) on a research project related to hurricane wave and surge loads on coastal structures) and one student was admitted to UCF/LSU (working on the ADCIRC model (setup and parameterization) and how to run simulations on a high-performance computing cluster).
- Further interactions have taken place with other CRC research and educational PI's but most of pending actions are focused on Year 2 activities.

## 13. Publications:

- Robert W. Whalin of Jackson State University and Ismael Pagán-Trinidad of the University of Puerto Rico at Mayagüez, along with co-authors from the US Army Engineer Research and Development Center (ERDC), presented a paper entitled "A Quarter Century of Resounding Success for a University/Federal Laboratory Partnership" at the Minorities in Engineering Division Technical Session on June 27. The paper is to be published in the Conference Proceedings. Submitted April 2016.

**14. CRC Performance Metrics:**

<b>CRC Performance Metrics</b>			
<b>Metric</b>	<b>Research</b>	<b>Education</b>	<b>Center</b>
Courses/certificates developed, taught, and/or modified		See Table	
Enrollments in Center-supported courses/certificates			
HS-related internships (number)		10	
Undergraduates provided tuition/fee support (number)			
Undergraduate students provided stipends (number)			
Graduate students provided tuition/fee support		5	
Graduate students provided stipends (number)		6	
Undergraduates who received HS-related degrees			
Graduate students who received HS-related degrees			
Certificates awarded (number)			
Graduates who obtained HS-related employment			
SUMREX program students hosted (number)			
Lectures/presentations/seminars at Center partners			
DHS MSI Summer Research Teams hosted (number)			
Journal articles submitted (number)		1 (2016	
Journal articles published (number)		1 (to be	
Conference presentations made (number)		2	
Other presentations, interviews, etc. (number)		2	
Patent applications filed (number)			
Patents awarded (number)			
Trademarks/copyrights filed (number)			
Requests for assistance/advice from DHS agencies			
Requests for assistance/advice from other Federal		5	
Total milestones for reporting period (number)			
Accomplished fully (number)		2	
Accomplished partially (number)			
Not accomplished (number)			
Product/s delivered to end-user/s (description and	See Table		
External funding received	See Table		
Leveraged support			
Articles on Center-related work published on website			
Coverage in media, blogs (number)			
Social media followers (number)			
Posts to social media accounts (number)			
Events hosted (number)			
Website hits (number)			

**Table for Documenting CRC Education Project Courses and Enrollments**

Courses Developed and Taught by <b>University of Puerto Rico at Mayaguez</b> under Project <b>Education for Improving Resiliency of Coastal Infrastructure (RCI)</b>						
Course		Developed (D), Revised (R), and/or Taught (T), by Project Year				
Number	Title	1	2	3	4	5
INCI6XXX INCI5XXX	<b>“Coastal Resilient Structures (under development)”</b> - Dual codes for undergraduates and graduates	D				
Offering: Elective (E), Concentration (C), Minor (M)		E				
Enrollment		-				
CMOF8990	Special Problems in Physical Oceanography (Graduate): <ul style="list-style-type: none"> <li>• <b>“FUNWAVE Test Bed”</b></li> <li>• <b>“Wave Energy Dissipation Derived from Video Imagery”</b></li> </ul>	T				
Offering: Elective (E), Concentration (C), Minor (M)		E				
Enrollment		2				
INCI6995	CE Special Problems (Graduate): <ul style="list-style-type: none"> <li>• <b>“A Novel Boussinesq -Type Numerical Wave Model Development”</b></li> <li>• <b>“Stochastic Simulation of Tropical Cyclones for the Quantification of Uncertainty Associated with Storm Recurrence and Intensity: Phase II”</b></li> <li>• <b>“Analysis of a Ring Levee Breach Using Adaptive Hydraulic”</b></li> </ul>	T				
Offering: Elective (E), Concentration (C), Minor (M)		E				
Enrollment		3				
INCI 5996	CE Special Problems (Undergraduate) <ul style="list-style-type: none"> <li>• <b>“Impact of Projected Sea Water Rise on Coastal Infrastructures”</b></li> </ul>	T				
Offering: Elective (E), Concentration (C), Minor (M)		E				
Enrollment		1				

**Table for Documenting External Funding and Leveraged Support**

External Funding			
Title	PI	Total Amount	Source
ERIP Summer Research Internship Program (BAA)	Pagan	\$95,760	ERDC-US Army Corp of Engineers

Grant) - ERDC Students paid under RA support			
<u>Leveraged Support</u>			
Description		Estimated Annual	
Release time for PI		\$9,845	
Release time for CoPI		\$11,019	
Climate Change Conference-Pagan & Lopez		\$25,000	