

TWILLEY, LSU
DHS Coastal Resilience Center
Research Project:
Annual Project Performance Report
Covers reporting period July 1, 2016 – June 30, 2017

1. Project Title:

Integrated Modeling Approaches with Application to Pre- and Post-Disaster Planning for Creating More Resilient Communities

2. Principal Investigator / Institution:

Robert R. Twilley, Louisiana Sea Grant/Oceanography & Coastal Science, LSU

3. Other Research Participants/Partners:

Jeff Carney, Coastal Sustainability Studio, LSU

Traci Birch, Coastal Sustainability Studio, LSU

Carola Kaiser, Center for Computation and Technology (CCT), LSU

Brant Mitchell, Stephenson Disaster Management Institute (SDMI), LSU

4. Short Project Description (“elevator speech”):

We propose a unique combination of research centers (Coastal Sustainability Studio (CSS) and Stephenson Disaster Management Institute (SDMI)) and a research and outreach organization (Louisiana Sea Grant College Program (LSG)) to develop pre- and post-disaster planning and adaptation tools for coastal communities to increase resilience. These efforts will enable vulnerable communities to plan, react, and recover more quickly and effectively in areas facing repetitive disturbance. The goals of the program are to improve emergency response with regard to protecting vulnerable infrastructure and populations, and to reduce repetitive loss by providing accurate impact data to community planners in the immediate aftermath of an event. This program focuses on significant reduction in risk with the use of high-fidelity storm surge data and impact scenario viewers during the pre-disaster planning and rapid reaction to storms, and accurate information useful to post-disaster recovery planning. Together this group will provide (1) planning tools that visualize aggregated risks to include hurricane force winds, storm surge, and inland flooding along with vulnerable populations based on socio-economic status; (2) modeling and visualization tools to communicate flood risks during a tropical cyclone event by identifying vulnerable populations and structures that are susceptible to storm surge; (3) provide post-landfall search and rescue grid system with prioritization based on socio-economic vulnerabilities; (4) develop methodology for helping community planning departments and recovery planning teams effectively utilize and implement changes to their built environment through effective resilience based planning. The CERA planning tool will incorporate many NOAA and other federal products (e.g., NOAA National Ocean Service, NOAA's River Forecast Centers, NOAA's National Centers for Environmental Information (NCEI), NOAA's Weather Prediction Center, and the NOAA

National shoreline data, along with USGS, and USACE) to inform local consequence model results. User groups and Sea Grant outreach program will be organized to facilitate awareness of products generated from this project, with focus on how to communicate vulnerable infrastructure and populations to regional planners.

5. Abstract:

We propose that an integration of coastal modeling tools linked to innovative design/planning approaches, together with effective outreach to both emergency managers and land use planners is needed to provide crucial community-level data for effective pre- and post-disaster planning. Beyond large-scale models or those that only demonstrate one aspect of hazard impact (e.g. storm surge), communities need clear guidance on exactly which vulnerable infrastructure and populations may be threatened and/or protected (pre-disaster planning and rapid response), and accurate post-event impact in order to make crucial land use and redevelopment decisions quickly. The ability to leverage this type of community-specific data provides the opportunity to avoid loss and rebuild for maximum future risk reduction. The trans-disciplinary LSU partnership builds on the strengths of each research center and outreach institution, and will provide transformational products to vulnerable communities to actively address improved flood prediction, protection, and response. We will incorporate established modeling outputs into a new consequence model showing how flood risk (both from storms and SLR) will impact people, industry, and infrastructure. This much-needed information will be used to enhance pre- and post-disaster planning for efforts. Louisiana Sea Grant and CSS will engage federal, state and local planners and emergency managers to incorporate these products into planning efforts. Beyond the targeted work being undertaken with established partner community(ies), the products will be tested at annual FEMA-lead hazard preparation workshops (i.e. Res/Con and LEPA) to engage end users directly in the development process, and will be leveraged to develop integrated approaches for university-based design studio courses and design/outreach entities addressing these issues.

6. End users:

This project, starting with the establishment of a focus group of federal, state and local planners and emergency managers, will determine what variables should be tracked in terms of consequences of storm surge to people, homes, and infrastructure to assist them in making critical decisions during and immediately following storm events. End users involved in this process will include: Federal Emergency Management Agency (FEMA), Department of Homeland Security (DHS) Federal Protective Services, the National Weather Service (NWS), Louisiana Governor's Office of Homeland Security and Emergency Preparedness (GOHSEP), the Louisiana Coastal Protection and Restoration Authority (CPRA), the Louisiana Department of Wildlife and Fisheries (LDWF), the Louisiana Office of Community Development (OCD), the US Department of Housing and Urban Development (HUD), the Louisiana Emergency Preparedness Association (LEPA), the Louisiana National Guard, US Coast Guard (8th District), the Mississippi Emergency Management Agency

(MEMA), The Coastal Protection and Restoration Authority (CPRA), local planners, emergency managers, and others. Each of the agencies described above have already been involved in the development of CERA and its use during several recent hurricane events, such as Hurricane Isaac. These agencies have made commitments through attendance at workshops dedicated to training on CERA products, and technology updates prior to hurricane season, that demonstrate the partnerships that exist to the project proposed. In addition, SDMI Has established relationships with local partner communities that will serve as case studies for the Consequence Model production and targeted planning efforts.

The CSS has a track record and established relationships with coastal communities throughout the MRD. In the wake of Hurricanes Gustav and Ike, CSS worked with 30 communities across the state to develop the Louisiana Resilience Assistance Program. This ongoing program connects architects, scientists, citizens and coastal managers to provide resilience planning assistance to communities across the coastal zone. Building on these established relationships and processes, CSS will engage coastal planners, emergency managers, and other stakeholders in the initial focus group, as well as later in the process to test the Consequence Model and planning framework. CSS will conduct workshop(s) directed at engaging communities through the use of case study scenarios to pilot the planning framework and Consequence Model. Tools and expertise developed through this project would be available to communities in Louisiana and beyond through the LRAP website www.resiliency.lsu.edu.

This project, starting with the establishment of a focus group of federal, state and local planners and emergency managers, will determine what variables should be tracked in terms of consequences of storm surge to people, homes, and infrastructure to assist them in making critical decisions during and immediately following storm events. End users involved in this process will include:

- Federal Emergency Management Agency (FEMA) - Federal Preparedness Coordinator
- Department of Homeland Security (DHS) Federal Protective Services - Protective Service Advisor
- National Weather Service (NWS) – Slidell/New Orleans Forecasting Office
- Louisiana Governor’s Office of Homeland Security and Emergency Preparedness (GOHSEP) – Christopher Guilbeaux, Deputy Director for Preparedness, Response and Interoperability-
- Louisiana Coastal Protection and Restoration Authority (CPRA) – Chris Ellis, Director
- Louisiana Department of Wildlife and Fisheries (LDWF) – Patrick Banks, Deputy Director
- Louisiana Office of Community Development (OCD) – Pat Forbes, Secretary
- Louisiana National Guard, - MAJ Robert Fudge
- US Coast Guard – Sector New Orleans - Port Security Specialist
- Local Planners –
 - Bob Rivers, Planning Director – City of New Orleans
 - Louisette Scott, Planning Director – City of Mandeville, LA
 - Chris Pulaski, Planning Director – Terrebonne Parish, LA
 - Doug Burguires, Assistant Planning Director, Lake Charles, LA

- Jennifer Gerbasi, Terrebonne Parish Recovery Planner
 - Dexter Accardo, Director - St. Tammany Parish OHSEP
- Emergency Managers –
 - John Rahaim, Director – St. Bernard Parish
 - Earl Eues, Director, Terrebonne Parish
- Sea Grant Agent - Kevin Savoie, Camaron Parish
- National Sea Grant Office – Dr. Dorn Carlson

7. Unanticipated Problems:

A huge effort was made to automate the workflow for the Consequence model. The scripts have been updated and produce now results down to the municipal level. The outcome was carefully tested and validated. This, however, took longer than expected so that the full integration with the CERA website could not be completely achieved. The CERA Planning website (cera-planning.cct.lsu.edu) shows some intermediate results for Vermillion parish. We will soon be able to show the final results from the Consequence model on this website and the CERA website for the Northern Gulf.

The full-scale development and deployment of a digital tool has not come together in a way that has allowed the pool to be fully engage in a design studio course. A studio was taught that utilized the existing CERA website to assist with research and design for a coastal residential development. Further, this has delayed follow up outreach with the end user groups to test the Consequence Model and planning framework

8. Project Impacts:

Many of the accomplishments listed below for research activities and milestones were actually accelerated due to the Louisiana Flood in August 2016. Several products requested by emergency managers and flood response agencies in planning for potential complicated flood impacts associated with the remainder of the 2016 hurricane season. There was particular concern that a hurricane following the August 2016 precipitation flooding would complicated inland flooding in the event of a coastal storm surge. These scenarios brought attention to the tools that are being developed as part of the CRC.

We are confident to integrate the final products of the Consequence Model into the CERA real-time web mapping interface in the next couple of weeks. They will be available for the peak of the hurricane season 2017. This is a major accomplishment and will be a tremendous asset to GOHSEP, local emergency managers, and planners in Louisiana.

9. Research Activity and Milestone Progress:

Research Activities and Milestones: Progress to Date

| Reporting Period 7/1/2016 – 6/30/2017 | | | |
|---|--------------------------|------------|--|
| Research Activity | Proposed Completion Date | % Complete | Explanation of why activity / milestone was not reached, and when completion is expected |
| Link CERA website with consequence analysis of SDMI. Complete cyberinfrastructure development to transfer information from CERA to GIS platforms to expand the utility of products associated with critical infrastructure along the coast. | June 2017 | 80 % | 100% in completion the cyberinfrastructure to transfer the data to GIS platforms and to the consequence model. Speed improvements for the consequence model still planned. Link to the CERA website will be available in ~ 6 weeks. |
| Design and build an automated model in ArcGIS to interpret outputs of ADCIRC to analyze the consequences of expected storm surge. | Jan 2017 | 100% | |
| Test Model utilizing 143,000 point infrastructure database for the State of Louisiana and historical storms to determine effectiveness of consequences. | June 2017 | 100% | Now that the scripts are in place we can add and modify layers as needed. We are finishing a full output run for Hurricane Isaac this week which is integrating the database. |
| Determine most effective means to present results of the consequence model on the CERA website. | June 2017 | 100% | Links will be provided on the CERA website to access directly the results from SDMI. |
| Integrate available data into a Consequence Model that can analyze storm surge impacts to build SSVI for pilot parish(es) | June 2017 | 100 % | |
| Link Consequence Model and SSVI with recovery/adaptation planning model to expand the resilience of industry, critical infrastructure, and communities along the coast. | June 2017 | 10 % | We anticipate a substantial level of accomplishment on this particular task in the next six weeks. |
| Use HAZUS to augment the actual CI/KR structures that will be part of the Consequence Model output and to provide estimates on actual damages | June 2017 | 70% | This task is behind as a result of upgrading our computers earlier in the year. There was an unknown conflict with HAZUS and Windows 10. Portions of HAZUS-MH 4.0 were being tagged by Windows Defender as a virus prohibiting HAZUS from completely installing. |

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| | | | In addition, a patch was recently released for ArcGIS 10.4 that was required for HAZUS to run properly. The fix was just provided to us on the 12 th and we will continue working on this milestone over the next two months. |
| Research Milestone | | | |
| Conduct model usability testing with identified stakeholders | June 2017 | 100% | |
| Present integrated CERA Consequence Model at professional conference | June 2017 | 100% | |
| Develop final SSVI for pilot parish(es) | June 2017 | 100% | |
| Conduct recovery planning/CERA integration workshop at LEPA/GOHSEP conference | June 2017 | 0 % | We missed a window to submit a proposal for this workshop in early spring 2017 and will have to wait for the spring 2018 LEPA conference. (Louisiana Emergency Preparedness Association meets first week of May each year) |

10. Transition Activity and Milestone Progress:

Transition Activities and Milestones: Progress to Date

| Reporting Period 7/1/2016 – 6/30/2017 | | | |
|---|---------------------------------|-------------------|---|
| Transition Activity | Proposed Completion Date | % Complete | Explanation of why activity / milestone was not reached, and when completion is expected |
| Compile results of Consequence Modeling workshop into CERA capability. The development of CERA has always been driven by suggestions and requirements by our clients and users. Feedback and workshop results are always considered and carefully reviewed. If appropriate, such results will be incorporated into the CERA software. | June 2017 | 70% | Delayed due to continued script writing for the consequence model. Will be completed in approximately six weeks prior to the peak of the 2017 Hurricane Season. |
| Conduct research studio in designing integration of CERA consequence tool with SSVI application tool to develop visualization and informatics. | Aug 2016 | 25% | Two courses have been taught engaging the tools from this grant but have yet to be implemented fully as a course focus due to lack |

| | | | |
|--|-----------|------|---|
| | | | of tool completion in time for course development |
| Partner with GOHSEP and the LA National Guard as part of the hurricane planning exercise by developing products for the exercise in preparation for 2017 hurricane season. | June 2017 | 100% | This milestone was accelerated to meet requirements for the 2016 Hurricane Season as a result of the August 2016 floods. |
| | | | |
| Transition Milestone | | | |
| Completion of course that includes advisors from federal and state agencies to assist students in developing an integrated communication tool | June 2017 | 25% | Two courses have been taught engaging the tools from this grant but have yet to be implemented fully as a course focus due to lack of tool completion in time for course development |
| Provide maps and flooding scenarios as part of the GOHSEP and LA National Guard planning exercise | June 2017 | 100% | Completed in August 2016 during the August floods in which an exercise for the Governor and his Unified Command Group. Scenario was developed using ADCIRC and the Consequence Model for a hurricane impacting Louisiana during the recovery from the August 2016 floods. |

11. Interactions with education projects:

None during this reporting period.

12. Publications:

None during this reporting period.

13. Tables:

Table 1: Documenting CRC Research Project Product Delivery

| <u>Product Name</u> | <u>Product Type</u> | <u>Approx. Delivery Date</u> | <u>Recipient or Anticipated End Users</u> |
|---------------------|---------------------------|------------------------------|---|
| CERA | Software | June 2017 | See list of users in item #6 above |
| Consequence Model | Software addition to CERA | December 2017 | See list of users in item #6 above |

Table 2: Documenting External Funding and Leveraged Support

| <u>External Funding</u> | | | |
|--|----------------------------|---------------------|-------------------|
| <u>Title</u> | <u>PI</u> | <u>Total Amount</u> | <u>Source</u> |
| Improved Algorithms for Computing Storm Surge (STORM) | Twilley, co-PI | \$206,560 | NSF |
| Coastal SEES Project on Accelerated Flood Risk with Delta Degrdation | Twilley, PI | \$298,683 | NSF |
| Cyber SEES – Simulation Management System for Flood Modeling | Twilley, co-PI | \$75,000 | NSF |
| Port Resilience Index | Twilley, PI | \$20,000 | NOAA |
| Louisiana Community Resilience Institute I | Carney, PI Birch, Co-PI | \$50,000 | Kresge, Sea Grant |
| Louisiana Community Resilience Institute II+III | Carney, PI Birch, Co-PI | \$150,000 | FEMA, NOAA |

| <u>Leveraged Support</u> | |
|---|-------------------------------|
| <u>Description</u> | <u>Estimated Annual Value</u> |
| Free office space | \$14,000 |
| Portion of university indirect returned to project | \$13,240 |
| Reduced rates on high performance computer | \$25,000 |
| Support for ASGS development by Louisiana Sea Grant | \$25,000 |

14. Metrics:

| Metric | Year 1 (1/1/16 – 6/30/16) | Year 2 (7/1/16 – 6/30/17) |
|--|--|--|
| HS-related internships (number) | | |
| Undergraduates provided tuition/fee support (number) | | |
| Undergraduate students provided stipends (number) | 1 | 1 |
| Graduate students provided tuition/fee support (number) | 1 | 1 |
| Graduate students provided stipends (number) | 1 | 1 |
| Undergraduates who received HS-related degrees (number) | | |
| Graduate students who received HS-related degrees (number) | | |
| Graduates who obtained HS-related employment (number) | | |
| SUMREX program students hosted (number) | | |
| Lectures/presentations/seminars at Center partners (number) | 1 | 2 |
| DHS MSI Summer Research Teams hosted (number) | | |
| Journal articles submitted (number) | | |
| Journal articles published (number) | | |
| Conference presentations made (number) | 5 | 3 |
| Other presentations, interviews, etc. (number) | 6 | 2 |
| Patent applications filed (number) | | |
| Patents awarded (number) | | |
| Trademarks/copyrights filed (number) | | |
| Requests for assistance/advice from DHS agencies (number) | 7 | 6 |
| Requests for assistance/advice from other Federal agencies or state/local governments (number) | 5 | 4 |
| Total milestones for reporting period (number) | 8 | |
| Accomplished fully (number) | 3 | |
| Accomplished partially (number) | 5 | |
| Not accomplished (number) | 0 | |