

**TWILLEY, LSU
DHS COASTAL RESILIENCE CENTER
RESEARCH PROJECT
YEAR 4 PROGRESS REPORT
July 1, 2018 – June 30, 2019**

Project Title:

Integrating CERA-Planning Software to support DHS Modeling and Planning Efforts for more Resilient Communities

Principal Investigator Name/Institution:

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Other Research Partners/Institutions:

- Traci Birch, Coastal Sustainability Studio, LSU
- Carola Kaiser, Center for Computation and Technology (CCT)
- LSU Brant Mitchell, Stephenson Disaster Management Institute (SDMI), LSU

Short Project Description (“elevator speech”):

We propose to investigate how some of the skills developed within CERA-Planning can be integrated into some of the flood exposure and damage modeling techniques that have been developed to evaluate impact of natural hazards to improve planning. The approach is to test whether some of the skills that have been developed within CERA/ASGS and incorporated into CERA-Planning to describe flood exposure and impacts can contribute to the existing flood consequence modeling within FEMA and NIST.

1. Introduction and project overview:

We propose that the CERA-Planning tool, as a next step innovation to CERA/ASGS, can provide additional skills to existing community resilience tools within NIST and DHS sectors such as HAZUS FLOOD. The high scale resolution of flood exposure presented in an innovative communication platform may prove to be a valuable tool to innovate design/planning approaches. 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 to make crucial land use and redevelopment decisions during initial stages of recovery. The ability to leverage this type of community-specific data along with fine-scale modeling of flood exposure (in a universal communication platform) provides the opportunity to avoid loss and rebuild for maximum future risk reduction. The proposed LSU partnership with DHS sectors using CERA-Planning builds on the strengths of existing flood hazard and community planning approaches with the innovation of flood modeling developed

with CRC. The transformational products proposed will allow vulnerable communities to actively address improved flood prediction, protection, and response. We will incorporate established modeling outputs into existing consequence models (HAZUS FLOOD) and community resilience guidelines (NIST Community Resilience Program) 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 efforts. The products will be tested with communities in the Gulf region that have experienced repetitive losses to flood events. Community engagement with end users directly in the development process will be leveraged using university-based design studio projects and design/outreach activities (such as those within Sea Grant Community Resilience focus area).

These enhancements will focus on the ability of consequence modeling platforms to enable vulnerable communities to plan in areas facing repetitive disturbance. The goals of the program are to migrate technologies developed in the CRC to enhance flood prediction and emergency management to modeling tools and planning toolkits that are designed to protect vulnerable infrastructure and populations, and to reduce repetitive loss by providing accurate potential impact data to community planners. This program focuses on significant reduction in risk with the use of high-fidelity storm surge data and impact scenario viewers useful to post-disaster recovery planning. Together this group will test what skill sets in the CERA/ASGS modeling platform may enhance the following: (1) planning tools that are being developed by NIST Community Resilience program that may help to visualize aggregated risks to include hurricane force winds, storm surge, and inland flooding along with vulnerable populations based on socio-economic status; (2) test and migrate modeling and visualization tools to communicate flood risks during a tropical cyclone event to HAZUS FLOOD to assist in identifying vulnerable populations and structures that are susceptible to storm surge; (3) run comparative tests of CERA-Planning with HAZUS FLOOD over test beds associated with Hurricanes Matthew and Irma in the Gulf of Mexico region; (4) work with Texas A&M and NIST collaborators in testing planning guidance tools to improve resilience based on CERA-Planning tool. The CERA-Planning tool will work with NIST and HAZUS FLOOD group to integrate data sets and scenario analysis to inform consequence model results.

2. Results:

The original intent for CERA was to present results to emergency managers, and that was the focus of benefits with initial developments in consequence modeling. In the last year, our focus has been to impact the thinking and actions of existing hazard and resilience planning tools within NIST and other DHS sectors (HAZUS, FEMA). Our efforts have focused on how our experience in building integrated modeling information for future hazard mitigation decisions can be used to promote programs within NIST and FEMA (Fig. 1). The proposed project utilized discussions with DHS and CRC leadership to determine how outcomes of the CERA-Planning tool can be integrated into existing federal systems and training opportunities to improve planning actions creating more resilient communities. We held a series of videoconference and attended workshops to integrate CERA-Planning with existing tools currently used or developed by DHS partners to expand the utility of previous investments by DHS to ASGS-CERA capacity.

Collaborating with NIST and FEMA groups has been extremely helpful to our project and we have contacts with individuals involved with these efforts. We report on possibilities to integrate the results of this project with existing tools currently used or developed by DHS. The products of CERA also help to inform other tool development programs on what specific information may be most effective in changing the perspective of planning process (see discussion at HAZUS workshop held in June 2019). Thus, CERA-Planning is not another tool as much as CERA-Planning is a tool that is testing a variety of techniques to be more effective in communicating the risk of flooding on planning analyses and decisions. Discussions are reported with the NIST Community Resilient program to see how information from CERA-Planning may be used in the guidance documents that are being developed for communities. CERA-Planning (and CERA/ASGS) can provide scenario analyses for NIST to test different capabilities of guidance documents. This expansion in model capability has been identified as having parallel training efforts at the state, regional and national level in coordination with present APA training efforts (see specifics outlined below).

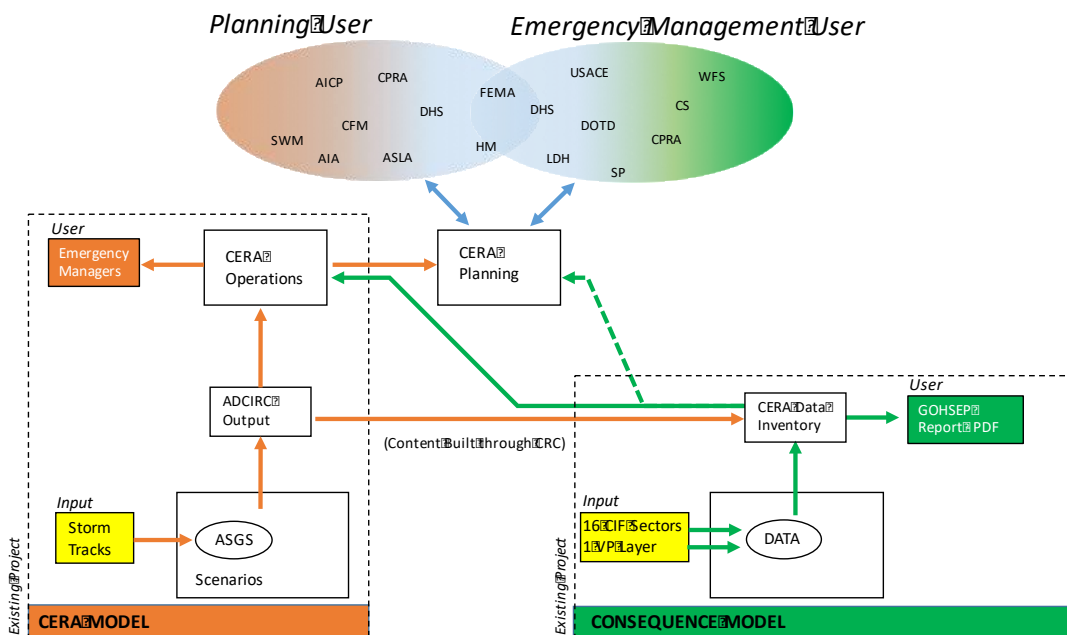


Figure 1. Diagram that demonstrates the development of the CERA model originally for emergency managers (CERA Operations) to the proposed CERA for planners (CERA Planning); and the linkages to the Consequence Modeling.

Activities over the last year have been involved with developing greater utility in CERA-Planning to help neighborhood, city, regional planners determine future land-use planning decisions based on future risk scenarios and flood vulnerabilities using the needs of programs and models developed within NIST and FEMA.

- Conference calls and webinar with NIST was organized during spring and summer 2018 to initiate the utility of CERA Planning into those techniques and guidelines. In addition, efforts have been initiated, at the request of FEMA, to test the application of CERA Planning with the mitigation planning guidelines that are being developed at Texas A&M by Dr. Phil Burke. Both of these efforts are in the stage of identifying coastal communities in Louisiana to apply the NIST and TAMU techniques, and test the application of CERA Planning to those case studies.
- Continue develop CERA-Planning Model to capture the diversity of coastal infrastructure and assets for scenarios of Hurricanes Matthew and Irma
- Held technical workshop with Hazus-FLOOD modelers and developers to identify how CERA-Planning tool can provide additional high-resolution input data on flood conditions during an event on June 9-10, 2019. Participants that focused on the use of CERA-Planning and ADCIRC with Hazus capability included the following: Rick Luettich (University of North Carolina), Brian Blanton (University of North Carolina), Carola Kaiser (Louisiana State University), Robert Twilley (Louisiana State University), Hazus developer, FEMA developer, Hazus lead, Hazus program integration. Plans for YEAR 5 to link CERA-Planning and Hazus include the following:
 - ADCIRC team will make both wind and flood hazard data from Michael available on the THREDDS server for Hazus experimentation
 - Hazus will experiment with data formatting options for unstructured ADCIRC grids – NetCDF, GeoTIFF, etc.
 - Hazus will determine path forward for dynamic integration of ADCIRC data – THREDDS server vs. CERA website
 - Hazus will work with ADCIRC team as next Hazus release is developed to test ADCIRC data integration functionality
 - Hazus will develop messaging for user community on new ADCIRC hazard data applications
 - ADCIRC team will send along any useful documentation/publications on the development of ADCIRC data
- On site visits at UT Austin (July 2018 and April 2019) to meet with Gordon Wells, Texas SOC for potential further improvement of the CERA tool, e.g., the use of satellite imagery and oil pipelines following the impacts of Hurricane Harvey in the TX Houston area
- Conducted a CERA tutorial session at the ADCIRC Bootcamp week 2019 (April 2019, Austin). Attendees included
 - Heath E. Jones (Director of Operations for the New Orleans District of the US Army Corps of Engineers, New Orleans)
 - US Coast Guard Incident Management Sector Chief
 - Katie Breland (Texas Task Force 1 swift water rescue)

- Gordon Wells (Texas State Operations Center and Program Manager at the Center for Space Research at the University of Texas at Austin)
- Phillipe Tissot (Research Professor at the Texas A&M University-Corpus Christi, teaching a course in Environmental Forecasting)
- Technical improvements of the CERA tool including the complete migration from Python version 2 to Python 3 and the Django web framework version 1 to version 2
- New CERA feature for hurricane season 2019: Implementation of real-time wind level stations as direct response of user feedback after hurricane Harvey
- Training of a Louisiana based ASGS operator in collaboration with CRC PI Dr. Jason Fleming; training of a CERA backup operator (in progress) for hurricane season 2019

3. End users:

- Research Engineer, Community Resilience Group, NIST, Section Chief, Infrastructure Development and Recovery at National Protection and Programs Directorate; Lead contact to establish integration of CERA-Planning into NIST Community Resilience Guidelines
- We engaged the Capital Region Planning Commission (CRPC; Kim Marousek, Director of Planning) to select community to utilize the NIST Community Resilience Guidelines and the CERA-Planning tool as envisioned from the design class as part of the LSU Coastal Sustainability Studio.
- NOAA Gulf of Mexico Regional Team (GoMRT) to incorporate NOAA tools into the Community Resilience Index that has been program supported by the Gulf of Mexico Alliance. The discussions have been centered around interest in using NOAA tools to support the Gulf of Mexico Community Resilience Index community engagements. CERA-Planning is working to be part of the hurricane scenario discussions that initiate the community engagement process.
- As of July 1, 2019, the CERA tool has 426 subscribed users including clients from DHS, FEMA, NOAA, USACE, USCG, USMC, TXSOC, CPRA, NWS, insurance companies, and the research community, among others.
- Collaboration with NOAA to integrate ESTOFS (Extratropical Surge and Tide Operational Forecast System) into CERA. ESTOFS has interest to use CERA platform at NOAA for disseminating model guidance to benefit NOAA and raise visibility of operational data already available.
- On-site visits at UT Austin (July 2018 and April 2019) to meet with Gordon Wells, TX SOC for potential further improvement of the CERA tool, e.g., the use of satellite imagery and oil pipelines following the impacts of hurricane Harvey in the TX Houston area
- CERA presentation at National Tropical Weather conference (April, 2019) engaged end users such as the following:
 - Director of the National Hurricane Center
 - Team lead of the NHC Storm Surge Unit
 - Lead Warning Coordination Meteorologist at the National Weather Service in Corpus Christi
 - Chief Forecast Operations, US Department of Commerce, NOAA
 - Several local emergency managers from Texas and media participants

4. Transition:

- The LSU CERA/ASGS team have been working with NIST to define how CERA-Planning can create test case scenarios of previous storms in selected locations to test the capacity of these new tools and guidelines in achieving the goals of the NIST
- Webinars with NIST have been held to define how CERA-Planning may be used in the presentation format used by NIST in community engagement to utilize the Community Resilience Planning Guide.
- The development of CERA-Planning tool has focused around the use of Hurricane Isaac and flood prone region of Northshore of Lake Pontchartrain to build an integrated system for community resilience.
- Presentation of the CERA tool at the ASBPA conference, Nov 2018 and the ESIP Winter Meeting. Introduction of CERA as a potential tool for the “Operational Readiness Level” that the ESIP Disaster Lifecycle Cluster is trying to establish in the community
- Presentations that describe the utility of CERA as communications tool continue to help provide utility of the ADCIRC Prediction System such as at the National Tropical Weather conference (April, 2019) that included National Hurricane Center, National Weather Service in Corpus Christie, Chief Forecast Operations of NOAA, and several local emergency managers from Texas and media participants.

5. Project Impact:

- Held technical workshop with Hazus-FLOOD modelers and developers to identify how CERA-Planning tool can provide additional high-resolution input data on flood conditions during an event on June 9-10, 2019.
- A contact to the HAZUS senior developer (Riskmap CDS), Ujvala Sharma with niyamIT, has been established at the FEMA Hazus workshop (June 2019). Access to the Hazus infrastructure database has been granted to the CERA team. The data will be evaluated for potential use in the CERA-Planning tool.
- CERA statistics for Hurricane Florence for the date range 8-15 September 2018 represents the growing impact of ADCIRC Prediction System (APS) during hurricane events. This project, along with support from Louisiana Sea Grant, continues to support the operations of APS during major events.
 - 154 new users requested a login during this time. Please see attached the screenshot "CERA_new-login_Florence_8-15Sep2018.png" for a breakdown.
 - 54,577 unique users have accessed the CERA website that is free for the public. They viewed a total of 152,905 CERA map displays. The peak was on Sep 11 with 17,609 unique users.
 - 368 CERA users with a login used the CERA website during the storm with a total of 6389 map views.

6. Unanticipated Problems:

There was a problem in making final links and implementation plans between the NIST Community Resilience Planning Guide and CERA-Planning. The plan was to engage a community resilient studio focused on how CERA-Planning could be implemented in community planning and use the NIST planning guide as tool to suggest tool augmentation in the

planning process. That studio was not finalized; and is planned again for fall semester 2019. The process lacks tool development skills needed to program CERA-Planning with data acquisition and visualization that is needed by the planning process; and clarity in how tools such as CERA-Planning can help develop scenarios that augment the resilient community planning process. Two solutions have been implemented to resolve these problems. First, a graduate student has been recruited that has undergraduate degree in civil engineering with interest in pursuing a graduate degree working on the CERA-Planning tool to augment planning process. The student has background and interest in regional planning and models that simulate flood risks. The student began working on the project in June 2019 and attended the Hazus workshop held in Washington DC. Second, contact was initiated with the Gulf Community Resilience Index team that has been focused on integrating NOAA tools to augment community resilience planning. This discussion, along with recent collaborations with Hazus development team, may help to define clarity in what information in hurricane scenarios would help the planning process to help communities reduce competitive losses. The new graduate student hired on this project will work on programming CERA-Planning using access to information in Hazus and working closely with the Gulf Community Resilience Index team to define what scenarios will help communities define needs for resilience planning.

7. Student Involvement and Awards:

- Nick Robles completed the requirements for a Masters of Science
- Undergraduate interns were supported in the LSU Coastal Sustainability Studio to assist with collecting and organizing GIS information on the 2016 Louisiana Flood.
- New graduate student, Katherine Jones, has been hired to program CERA-Planning to augment regional planning for community resilience

8. Interactions with education projects:

N/A

9. Publications:

N/A

10. Year 4 Research Activities and Milestone Achievements:

Year 4 Research Activities and Milestones: Status as of 6/30/2019

Reporting Period 7/1/2018 – 6/30/2019			
Research Activity	Proposed Completion Date	% Complete	Explanation of why activity/milestone was not completed
Continue to develop CERA-Planning Model to capture damage to diverse coastal infrastructure and community assets associated with Hurricane Isaac	12/2018	70%	Need to implement studio on community resilience planning
Conduct analysis of hurricane impact scenarios from Hurricane Isaac to capture the diversity of recovery and adaptation needs for community planning to augment workshop activities with partner community planned in 2019.	12/2018	50%	Need to implement studio on community resilience planning
Determine available data to be used in building CERA-Planning based upon Hurricane Isaac that provide technical assistance in use of NIST Community Resilience Program guidelines.	06/2019	50%	Need to implement studio on community resilience planning and connect to NIST program
Research Milestone			
Identified scenarios using Hurricane Isaac that provide flooding outcomes and consequences that would be useful in workshop planning exercise using NIST guidance tools that augment technical quality of partner community planning process.	12/2018	70%	Need to implement studio on community resilience planning and connect to NIST program
Finalize compiling the data sets required to build CERA-Planning based upon Hurricane Isaac data sets and monitoring reports.	06/2019	50%	Need to implement studio on community resilience planning and connect to NIST program

11. Year 4 Transition Activities and Milestone Achievements:

Year 4 Transition Activities and Milestones: Status as of 6/30/2019

Reporting Period 7/1/2018 – 6/30/2019			
Transition Activity	Proposed Completion Date	% Complete	Explanation of why activity/milestone was not completed
Based upon discussions with NIST, determine process to engage CERA-Planning into process development of Community Resilience Program.	12/2018	80%	Discussions with NIST have identified process but need to simulate community augmentation with studio
Link CERA-Planning with NIST Community Resilience program using Hurricane Isaac as example of how flood modeling can improve community impact using present community planning guidelines	12/2018	50%	Discussions with NIST have identified process but need to simulate community augmentation with studio
Meet with Capital and/or New Orleans Regional Planning Commission staff to discuss candidate partner communities to augment planning process using CERA-Planning and NIST Community Resilience Program guidelines.	03/2019	50%	Discussions with NIST and Capital Regional Planning Commission have been initiated; but need to define tools to augment process, which is planned with fall 2019 studio
Transition Milestone			
Select a partner community to test benefit of CERA-Planning/NIST Community Resilience program based on present protocols and criteria that exist in community planning effort	12/2018	50%	Discussions with NIST and Capital Regional Planning Commission have been initiated; but need to define tools to augment process, which is planned with fall 2019 studio
Execute a workshop with selected community partner demonstrating value added of the CERA-Planning with NIST Community Resilience Program to augment technical assistance in planning efforts.	06/2019	25%	Discussions with NIST and Capital Regional Planning Commission have been initiated; but need to define tools to augment process, which is planned with fall 2019 studio

12. Tables:

Table 1: Research Project Product Delivery

Product Name	Product Type (e.g., software, guidance document, knowledge product)	Delivery Date	Recipient or End User(s)
Open DAP Server	OpenDap is a webserver technology that runs on dedicated servers at CCT/LSU and RENC/UNC. It is used to store ADCIRC simulation results produced by the ASGS in a data archive on those servers. The data files provided on the OpenDap servers will be downloaded and consumed by CERA to visualize ADCIRC simulations with the goal to present the maps on the CERA website.	December 2018	Customers using CERA on line products
Updates to CERA software	Complete migration from Python version 2 to Python 3 and the Django web framework version 1 to version 2	December 2018	Customers using CERA on line products

Table 2: TWILLEY Performance Metrics:

Metric	Year 1 (1/1/16 – 6/30/16)	Year 2 (7/1/16 – 6/30/17)	Year 3 (7/1/17- 6/30/18)	Year 4 (7/1/18- 6/30/19)
HS-related internships (number)				
Undergraduates provided tuition/fee support (number)				
Undergraduate students provided stipends (number)	1	1	1	0
Graduate students provided tuition/fee support (number)	1	1	1	1
Graduate students provided stipends (number)	1	1	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	3	3
DHS MSI Summer Research Teams hosted (number)				
Journal articles submitted (number)				
Journal articles published (number)				
Conference presentations made (number)	5	3	3	4
Other presentations, interviews, etc. (number)	6	2	3	2
Patent applications filed (number)				
Patents awarded (number)				
Trademarks/copyrights filed (number)				
Requests for assistance/advice from DHS agencies (number)	7	6	11	18
Requests for assistance/advice from other Federal agencies or state/local governments (number)	5	4	3	55,000*
Dollar amount of external funding	\$650,243	\$800,243	\$575,243	\$575,243
Total milestones for reporting period (number)	8			
Accomplished fully (number)	3			
Accomplished partially (number)	5			
Not accomplished (number)	0			

* See discussion on users for CERA during 2018 hurricane season