Smart Sea Level Tools for Emergency Planning and Response in and around Savannah, Georgia

Georgia Smart Communities Challenge 2018
Proposal ID **LJEPWT**

Proposal Lead

Chatham County, GA
A Georgia Community

In Collaboration With

City of Savannah, GA
Creative Coast, Savannah, GA

Point of Contact

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Project Narrative

1.1 Vision

Coastal flooding represents a growing threat to the City of Savannah and adjoining areas in Chatham County, which are home to diverse communities rich with cultural heritage and thriving economies. Recent brushes with Hurricane Matthew in 2016 and Hurricane Irma in 2017 saw storm surges of 11-12ft at the county's only two tide gauges (https://tidesandcurrents.noaa.gov/), shutting down county schools and businesses for days on end. During these extreme weather events, strong winds from shifting directions interacted with an extremely intricate network of coastal rivers, tributaries, and marshlands to create a complex pattern of flooding that varied by 2-4ft over a distance of several miles. When the storms had passed, some communities and critical infrastructure that had been spared during Matthew were extensively flooded during Irma, and vice versa, even though the official tide gauges registered almost the exact same storm surge along the Savannah River.

In order to establish effective emergency response plans following these kinds of natural disasters, officials from the Chatham Emergency Management Agency (CEMA) and the City of Savannah require real-time information about the water levels across the area. Where is it safe to send relief crews, utility repair crews, and other essential response personnel? And did floodwaters expose critical public infrastructure such as electrical substations, bridges, schools, or municipal water facilities to potential damage that would represent an acute public hazard?

This Georgia Smart Communities proposal seeks funds to initiate a collaborative planning process around the deployment of a small pilot network of inexpensive, network-enabled sea level sensors in the City of Savannah and surrounding areas in Chatham County. The proposed project represents a partnership between the City of Savannah officials (Office of the Mayor, the Office of Sustainability, the Development Services Department, and the Department of Emergency Management) and CEMA, together with Georgia Tech researchers from the College of Computing, College of Science, College of Engineering, and the Center for Education Integrating Science, Mathematics, and Computing (CEISMC). This is the first project of its kind in the region, and could provide a template for future Smart applications in other areas of Georgia's vulnerable coastline.

The year-long pilot will focus on achieving the following goals:
i) designing a pilot network of several dozen sea level sensors and related equipment, with locations chosen collaboratively by the team during a Summer, 2018 planning workshop
ii) testing the capacity of the network to supply real-time information to government officials and other key stakeholders
iii) designing pilot online platforms for real-time, raw data aggregation and visualization
iv) performing preliminary assessments of flood risk given a variety of different environmental conditions (e.g. various hurricane directions and strength, king versus neap tides, heavy rain, etc), including appropriate GIS-enabled maps and visualizations
iv) engaging a diverse set of coastal residents and stakeholders to explore how the community could access the data and tools for their benefit

In the short term, we hope to learn about the strengths and weaknesses of the sensor array for emergency planning and response purposes, and are excited at the prospect of getting sensors
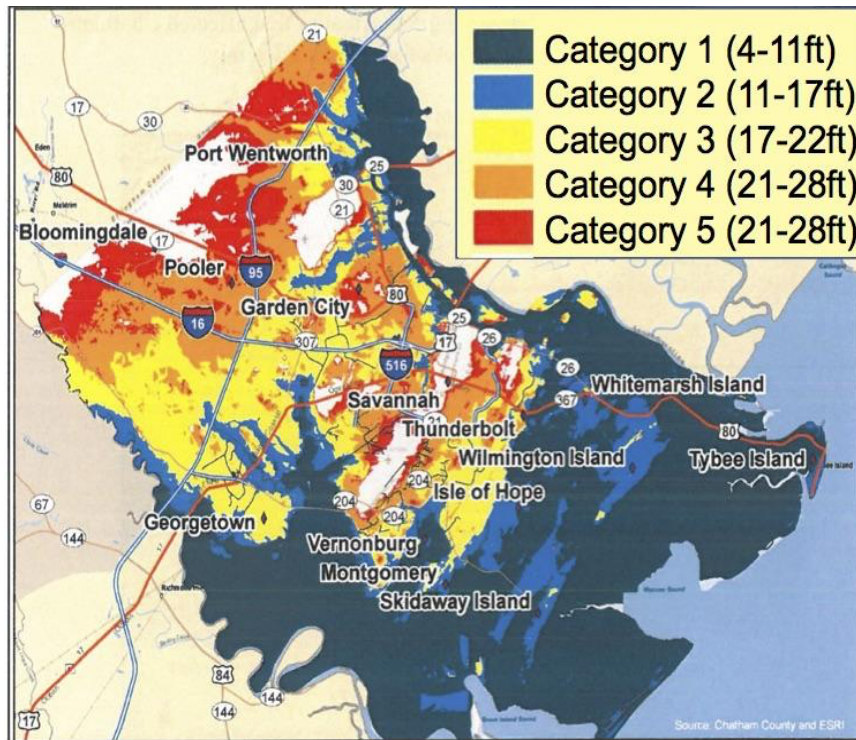
Figure 1. Potential storm surge levels, Chatham County. Source: Chatham County Pre-Disaster Mitigation Plan, 2010. Note the location of Whitemarsh Island, where the first sea level sensor will be deployed in May, 2018.

deployed ahead of the 2018 hurricane season. In the long term, we envision that this year-long project will serve as the foundation for the design of a comprehensive network of smart sea level sensors and data management toolkits. When combined with output from numerical coastal ocean models of coastal flooding probabilities, such data could guide strategic investments in flood mitigation measures such as raised causeways, reinforced bridges, sea walls, etc in the Savannah area and beyond. While this proposal is focused on sea level rise, it is important to note that the sensor technology enables the measurement of additional environmental variables of interest such as water temperature, oxygen levels, turbidity, etc.

Our pilot project involves a close partnership with Creative Coast (see attached supporting letter), a Savannah-based consortium of technology- and innovation-focused community interests. They will amplify our reach to key regional stakeholders who may become key partners in ensuring the success of the Georgia Smart Communities project and/or use the project's datasets and/or other products to advance future Smart initiatives. We also intend to work with one Savannah-area public high school to develop some STEM classroom curriculum around the sea level data generated by the project.

Most uniquely, our project also leverages an on-going project led by researchers from Georgia Tech, UGA, and Emory University, and funded by Google, called "Climate Stories". It uses virtual reality to visualize and shape the narratives of climate impacts and climate solutions in communities throughout Georgia. Their first project, as it happens, will focus on sea level rise in Savannah and surrounding areas, and will include interviews with area residents impacted by

Hurricanes Matthew and Irma, as well as with individuals, companies, and municipalities working together to reduce the risks of future sea level rise in this area.

1.2 Framework

At its foundation, the implementation of the project will benefit from existing collaborations between the co-sponsoring governmental partners, City of Savannah and CEMA. Working closely with the Georgia Tech research team, they will convene key stakeholders from the region and discuss design constraints for the pilot sensor network. Once some preliminary data are available, subsequent meetings will discuss the design goals and constraints for a real-time data portal for the entire team to use and access the data. Throughout this process, the City of Savannah and CEMA will hold a series of small workshops to inform the best strategies for integrating the real-time sea level data into emergency planning and response plans.

1.3 Plan

Our plan represents a phased approach to the testing and design of a small sea level sensor network in parallel with the design of emergency planning and response strategies that could integrate this real-time data to the benefit of the community. Below we discuss the specific steps that underlie each of on the main goals listed in Section 1.1.

Goal 1: design a pilot network of several dozen sea level sensors, communication hubs, and related equipment

The sensor technology that we will use for this project is ideally suited for the application. For example, a sensor package option that is commercially available through http://flood.network, the ultrasound-based sensor ($500; Figure 2) can be mounted to bridge posts or other infrastructure, and will relay data back to an internet-connected gateway ($2,000) using wireless LoRaWAN technology with a range of 3 miles. A single gateway can stream data from dozens of individual sensors.

Figure 2. Photo of sea level sensor unit commercially available from https://flood.network.

Our goal is to install a pilot network across a ~20 square mile area spanning across both large rivers and small coastal channels, to capture the maximum spatial variability in our network. For this purpose, we require 5 gateways (5 x $2,000 = $10,000 in all) and 20 sea level sensors (20 x $500 = $10,000 in all) for a total of $20,000 of new equipment. Unit assembly and pre-testing ahead of any field deployment will be led by Dr. Russell Clark, who is already working with project partner Mr. Randall Mathews from CEMA to install the first test sea level sensor on Whitemarsh Island in coming weeks.

The gateway infrastructure will be configured to use the Things Network software and resources (www.thethingsnetwork.org). This is a worldwide community of open source software and network tools that promotes community involvement through shared infrastructure and tools. We will create and manage a Things Network community in Savannah and encourage others in the area to participate. We already have two initial gateways in the Savannah area and several on Georgia Tech's campus.

The design goals of the sensor network will be discussed at a 2-day scoping workshop to be held in Savannah in late May, 2018, where the team will conduct its first collaborative planning meeting. We will make every effort to get input from key stakeholders during the 2-day

workshop, but it is likely that the design considerations will require discussions with a broad range of stakeholders from CEMA and the City of Atlanta, as well as key entities like Georgia Power, broadband companies, and possibly even schools. Over a period of ~1 month we will draft and refine a preliminary deployment plan based on the initial scoping discussions, which we hope to finalize during a workshop during mid-July, 2018. The sensors will be installed over the month of August, just in time for the peak of the Atlantic hurricane season, by a team of City of Savannah and/or CEMA personnel, in close consultation with Dr. Russell Clark.

Goal 2: test the capacity of the network to supply real-time information to government officials and other key stakeholders

The team will explore different data collection frequencies and attend to any data quality issues early in the deployment timeframe, so that the user team can begin to design a user portal and other end uses for the sea level sensor data. The study will focus specifically on the tradeoffs to be made in the quest for long battery life on the remote sensors and assess the viability of the technology for these applications. We will adjust data sampling rates and gateway deployment density to determine the specific design parameters and costs for a long-term deployment. This initial troubleshooting and optimization phase should take approximately 2 months.
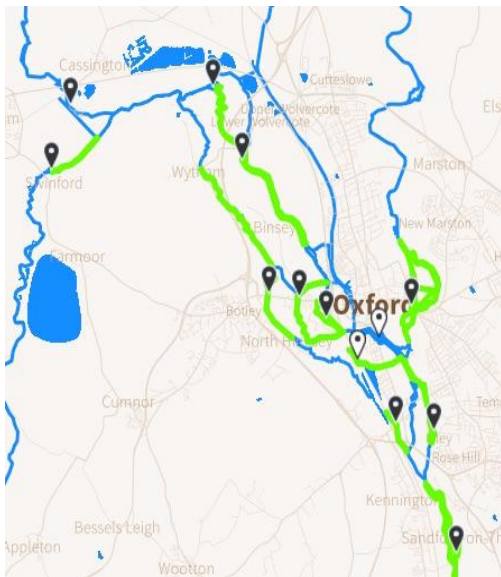
Figure 3. Example of mapping real-time flood risk around Oxford, UK, showing the location of sea level sensors. Green indicates normal water levels. Source: https://flood.network

Goal 3: design a pilot online platforms for real-time, raw data aggregation and visualization

Devices connected to the Internet will send raw time series data to the cloud, where it will undergo three main stages. First, raw data will pass through a number of pre-processing operations (eg, de-duplication, calculating aggregations, enriching with metadata, etc). Second, cleaned data will be stored as structured objects to enable fast querying. Third, structured data will be made available in formats that make it easy for users to explore and visualize, including a dashboard that visualizes sensor readings over time on a map (Figure 3) and an API for programmatic access. Georgia Tech Research Scientist Lalith Polepeddi will lead this effort, in close consultation with City of Atlanta and CEMA personnel to ensure ease of use and fit for purpose.

Goal 4: perform preliminary assessments of flood risk given a variety of different environmental conditions (e.g. various hurricane directions and strength, king versus neap tides, heavy rain, etc), including appropriate GIS-enabled maps and visualizations

As the team continues to collect data and build data analysis and visualization tools around the new sea level sensor network and associated data streams, it is important to realize that an integrated smart system for flood risk assessment must be informed by maps of past flood data, infrastructure, population, and other geospatial data. Towards this end, personnel from the City of Savannah, CEMA, and researchers from Georgia Tech will begin to lay the groundwork for a

revision to the flood risk maps that guide emergency planning and response. This is a particular specialty of Dr. David Frost, a civil engineer and natural disaster response specialist who will play a key role in this effort. This is an ambitious effort that will get underway during the year-long project, laying the groundwork for future funding requests to advance this initiative.

In addition to collating and integrating GIS datasets of community flood risk, flood prediction and vulnerability under a range of future environmental scenarios is critical to a comprehensive risk assessment, as past data is likely not indicative of future risk, giving rising sea levels. Coastal ocean modeling, which can be conducted with the exact Georgia coastline configuration and as a boundary condition, can combine varying wind speeds and direction with different tidal heights, and different global sea level rise assumptions, to inform a full portfolio of future coastal flooding risk in the domain area. Dr. Emanuele Di Lorenzo is an expert in coastal ocean modeling, and will conduct these simulations as part of this year-long project. As above, such work will lay the groundwork for future translational research in this important area.

Goal 5: engage a diverse set of coastal residents and stakeholders to explore how the community could access the data and tools for a variety of end uses
The project will create a web portal for open access to the sea level data in real-time, enabling a variety of citizen science and crowd-sourced efforts to take shape, as well as provide much-needed data for other end uses (be they industrial, educational, or commercial) in the Savannah area and beyond. We will engage with a range of stakeholders during the year-long project - in particular during Workshop #3 (see below) to try to design our data streams and user interfaces with a diverse range of end-uses in mind. We will also launch a web survey effort in partnership with the city to raise awareness about the project, to collect community input, and to engage a broader range of the public in the project events such as the Sea Level Rise Virtual Reality Showcase. The Savannah-based NGO Creative Coast will be a key partner for these activities.

This project addresses the **Smart Resilience** component of the Georgia Smart Communities Challenge, in building technology-enabled capacity to plan for, and mitigate the damages associated with coastal flooding along Georgia's coast.

1.4 Research

The main research activities that will be conducted as part of this research revolve around the following three research themes:

1) Computer Science & Engineering - Dr. Russell Clark and Lalith Polepeddi
The key research around the technology is to determine the viability of using these new Internet of Things-specific networks for a large scale smart communities application. The LoRa technology shows significant promise but has not yet been proven in this type of deployment. We will study the tradeoffs to be made in the quest for long battery life on the remote sensors and assess the viability of the technology for these applications. We will study various sensor placement options to determine the impact of various bridge construction (e.g. concrete vs steel) and radio interference. We will work with the community stakeholders to determine the best approach for deployment and maintenance of the equipment and identify the tools and techniques that will be required for long term success of the project. We will determine the data access controls and interfaces required by the stakeholders and design a data management plan that will support open access and community development as much as possible.

2) Coastal ocean modeling & predictive sea level risk assessment - Dr. Emanuele Di Lorenzo
Advances in high-resolution coastal ocean modeling now enable us to model and forecast the circulation and sea level dynamics in coastal environments (see Figure 4). Specifically, Dr. Di Lorenzo and Haas have developed a high-resolution implementation of the Regional Ocean Modeling System (ROMS) for the coast of Georgia. This model can simulate the sea level response to a variety of forcing events including tides, wind forcing, storms and hurricanes, and can be used to explore the sensitivity of sea level to different scenarios of both environmental forcing and human interventions (e.g. dredging that change local bathymetry). These types of simulations provide the physical data-basis for conducting local risk assessments.
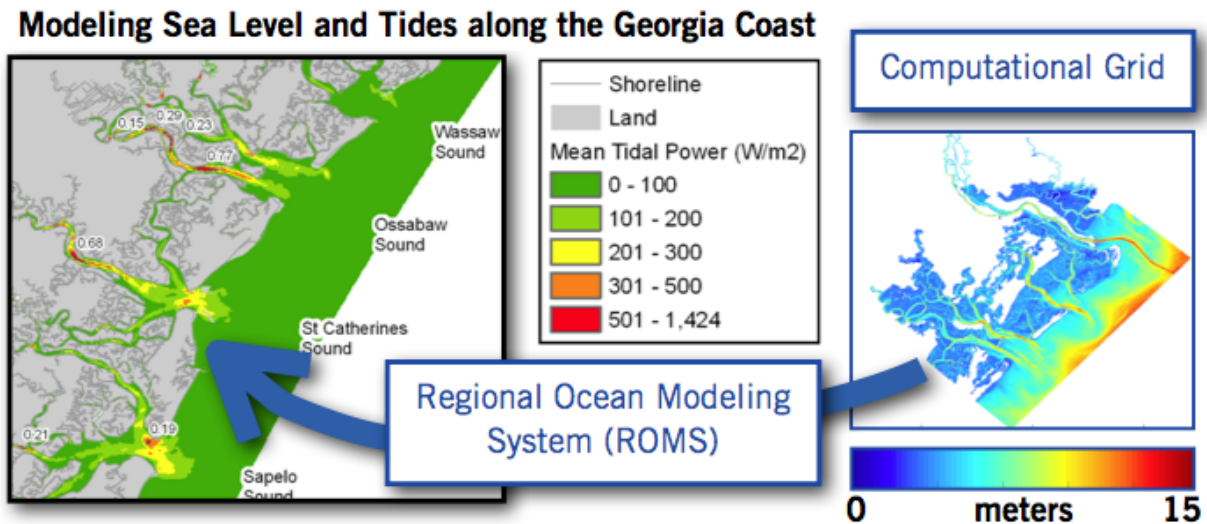
Figure 4: Example of high-resolution (1km to 22m) ocean model simulation of sea level and tides along the Georgia coast. The ROMS model is driven with large-scale tidal potentials, local surface winds and heat fluxes.

3) Coastal flooding risk assessment tools and approaches - Dr. David Frost
Ongoing research at Georgia Tech into coastal resilience involves a multi-disciplinary study to develop and demonstrate, through a set of "Use Cases", a framework and an associated suite of engineering-centered interdisciplinary tools for Sustainable Coastal Area Resilience Planning (SCARP). The proposed system is intended to provide a shared environment for technical driven collaboration that is linked to the core function of evaluating coastal resilience. Of particular importance is that the framework is being designed to facilitate discussion and interaction between technical experts and the community at large. To accomplish this, the SCARP framework will enhance an existing suite of decision support tools that incorporate multi-criteria analysis for sustainability evaluation of major civil infrastructure projects. Through the proposed project, the existing tools will be expanded to incorporate criteria that support planning actions in support of a new resilience evaluation framework and leverage the spatial analysis capabilities and data that exist with the SAGIS (Savannah Area GIS) system. Sea-level rise scenarios and coastal ocean model surge output provided by Dr. Di Lorenzo's efforts will also be leveraged to provide critical coastal scenario inputs to optimize community-level resilience.

Execution Plan

2.1 Cost Plan

The project costs can be divided into <u>five</u> main categories, which are supported by the indicated source of funding.

1) Sensors and Gateway Technology and Data/Information Support - $20,000 allocated by CEMA through their portion of matching funds. The $25,000 research grant to the Georgia Tech team will fund staff time to aid in the assembly and testing of the sensors at Georgia Tech, and a portion of staff time to aid in the development of the web data portal for the project. Both of these activities represent core deliverables for the project.
2) Staff time from City of Savannah, CEMA, and Chatham County - This line item represents a sizeable commitment of matching funds committed by both the City of Savannah and Chatham County governmental partners, as outlined in their supporting letters, and far exceeds the minimum contribution of $50,000, given the depth of expertise represented on the project team.
3) Workshops and Community meetings in Savannah - The three Savannah workshops are estimated at $5,000 per event for a total of $15,000 over the course of the year, and will be supported by the Smart Communities grant to the partners.
4) Web-site and communication/engagement infrastructure - Roughly $10,000 of the Smart Communities grant will be used to pay communication contractors to design a web-site for the Smart Sea Level project, part of which will house the real-time mapping component that represents a core technical deliverable for the project. In addition, the city will contract with a communications firm to design an online community forum to collect feedback on the project as it moves forward, and aid in the execution of a Sea Level Rise Virtual Reality Showcase to feature the early prototype of the "Climate Stories" component. These investments, while sizeable, are critical to the community engagement and awareness aspect of the project.
5) Preliminary planning studies to advance community resilience – The remainder of the Smart Communities grant (roughly $25,000) will be used to begin the planning process for a Savannah/Chatham County Community Resilience Master Plan, via contracts with outside master planning firms, that would incorporate the updated flood risk assessments.

2.2 Personnel Plan

Project Coordinator and Contact:
Kim Cobb; kcobb@eas.gatech.edu; 404-894-3895
We choose not to assign percent effort to the various team members below, recognizing that project roles will grow and shrink through different phases of the project (i.e. design of sensor network, installation of sensor network, design and review of web portal, community engagement, report writing, etc). We estimate that no one member of the project team will devote more than 5-10% of his/her effort to the project, averaged over the course of the project.

City of Savannah Team Members
Nick Deffley is the Director of the Office of Sustainability for the City of Savannah, and will serve as the main governmental liaison for the City of Savannah.
Eddie DeLoach is the Mayor of Savannah and was the first point of contact for the project with the City of Savannah. Upon his recommendation, personnel from other city Offices, including the City Manager Ron Hernandez, became involved in the project, and will form part of our key stakeholder team.

Heath Lloyd (see supporting letter) is the Director of the Office of Infrastructure and Development and will assist the team with the identification of appropriate installation points as well as provide coordination with relevant city staff to assist with installation, if needed. **Tom McDonald** (Flood Plain Manager) and **David Donnelly** (Emergency Manager) will also form part of the core project team from the City of Savannah.

Chatham County Team Members
Randall Mathews is the Emergency Management Coordinator for the Chatham Emergency Management Agency (CEMA), and will serve as the main governmental liaison for Chatham County portion of the project team, which combines members from CEMA.
Leon Davenport (see supporting letter) is the Chatham County Engineer who will dedicate 2 engineers and 2 GIS-specialized staff (specific personnel listed in letter) to the project.
Dennis Jones is the head of CEMA and has 28 years of emergency management response. Mr. Jones has been appointed to the Federal Emergency Management Agency's Hurricane Liaison Team which serves as a liaison between the National Hurricane Center and Emergency Management Agencies across the region during hurricane threats. Mr. Jones also serves as an Accreditation Manager who travels Nation-wide evaluating State and local emergency management programs

Georgia Tech Team Members
Kim Cobb is the Director of the Global Change Program and the Georgia Power Chair and Professor in Earth and Atmospheric Science. She is a climate scientist who specializes in the history of climate extremes that drive changes in North Atlantic hurricane activity, ocean temperature extremes, and regional ocean circulation. She also has extensive expertise in topics at the intersection of energy and climate, including over a decade of experience in communicating climate science to the public via television, print and online media, radio, and social media. She has extensive project management and facilitation skills through her roles as Principal Investigator on large federal collaborative grants and as Founding Director of the long-running Carbon Reduction Challenge.
Russell Clark is a Senior Research Scientist in the School of Computer Science at Georgia Tech. He has been teaching and leading research efforts in networking, mobile applications, and the Internet of Things. He has a half-time appointment with the Georgia Tech Savannah campus and is active in the Savannah community. Clark will lead the effort to develop and deploy the sensor and gateway infrastructure and will lead student teams to develop applications and data collection tools. He has been working with CEMA on the initial test deployment on Whitemarsh Island.
Emanuele Di Lorenzo is the Director of the Program in Ocean Science and Engineering and Professor in the School of Earth and Atmospheric Sciences at Georgia Tech. His research interests and expertise cover multi-scale climate and ocean dynamics (large-scale, regional and coastal), climate impacts on marine ecosystems and coastal social-ecological systems. Dr. Di Lorenzo is also vice-chairmen of the Science Board for the North Pacific Marine Science Organization, an intergovernmental organization that aims at translating disciplinary knowledge of the climate, ecological and human dimensions of the North Pacific system into integrated understanding and modeling.
David Frost is the Elizabeth and Bill Higginbotham Professor in Civil Engineering. He is co-chair of the NSF funded Geotechnical Extreme Events Reconnaissance (GEER) Association

which responds to natural disasters around the world that impact civil infrastructure. His research focuses on the development of digital data collection systems for studying infrastructure problems related to extreme events at multiple scales and he has received two US patents for multi-sensor systems. He has served on post-disaster study teams in US, Turkey, India, China, Chile and Japan as well as at the World Trade Center following the 9/11 attacks. He is the former Director of Georgia Tech's Savannah campus, and is a former long-time resident the area.

Jayma Koval is a Research Associate at Georgia Tech's Center for Education Integrating Science, Mathematics and Computing (CEISMC). Through this position she engages in educational research in the K-12 setting; develops curriculum for NSF and other large grant funded projects; and organizes and conducts teacher professional development sessions related to developed curriculum, STEM integration and NGSS alignment and implementation.

Lalith Polepeddi has a Masters Degree in Computer Science & Engineering from Georgia Tech, and is currently employed as a Research Scientist with the Global Change Program. His expertise includes building cloud systems to ingest, process, and store data from "Internet of Things" sensors; building APIs to make data available for use; creating machine learning models to make predictions based on past data. For this project, he is also Project Lead in a synergistic project to employ virtual reality to create climate stories that capture how climate change is affecting Georgia communities and what those communities are doing in response.

Georgia Smart Sea Level Tools Team

Georgia Tech	Chatham County	City of Savannah
Dr. Kim Cobb* **Professor**	Leon Davenport Chatham County Engineer	Mayor De Loach
Dr. Russell Clark Senior Researcher	Dennis Jones Emergency Management Director	Ron Hernandez *City Manager*
Dr. David Frost Professor		**Nick Deffley*** ***Director, Office of Sustainability***
Dr. Emanuele Di Lorenzo Professor	**Randall Mathews*** **Emergency Management Coordinator, CEMA**	Heath Lloyd Director, Office of Infrastructure & Development
Lalith Polepeddi Research Scientist	Bill Nicholson Senior Drainage Engineer	Tom McDonald Flood Plain Manager
Jayma Koval Education Coordinator, CEISMC	*** indicates lead contacts**	David Donnelly Emergency Manager

Project coordination

All three Savannah workshops mentioned below will be attended by as many of the project team members as possible, and project coordination will also continue remotely using a web-based project management system such as Monday.com. We will hold bi-weekly phone calls to

coordinate the various action items relevant to the different phases of the project and coordinate person-hour allocations to the project collaboratively. The Savannah workshops will be coordinated by administrative staff for the Global Change Program, working with relevant partners in Savannah, at no cost to the project.

2.3 Schedule

May, 2018: first sensor installed at Whitemarsh Island; project team scoping meeting in Savannah
July, 2018: **Savannah workshop #1** - finalize plan for deployment of 20 sea level sensors in greater Savannah area; includes external stakeholder engagement (Georgia Power, etc)
August, 2018: finish installing network of sensors
September, 2018: finish initial prototype of web-site for real-time mapping of sensor data
November, 2018: **Savannah workshop #2** - review 2-3 months of sea level data with entire project team; finalize design specs for continued web-site development; design workplan for spring, 2019; visit with high school principal and teachers to assess STEM curriculum potential
March/April 2019: **Savannah workshop #3** - external stakeholder and community engagement with prototype for real-time data visualization, providing feedback to project team to inform final assessment of longer-term viability of Smart Sea Level project and real and perceived value to the community
June, 2019: Submission of final report to Georgia Smart Communities team

2.4 Collaboration

2.4.1. Coordination of Governmental Agencies
The City of Savannah and CEMA have a long history of successful collaboration around the perennial threat of coastal flooding and response. The various personnel that will be involved in the project from both governmental organizations (detailed in letters of support) are all co-located in Savannah, where the three project workshops will be held, ensuring a close coordination of all key project decision points.

2.4.2. Development of K-12 classroom activities
As the school year gets underway in August, 2018, we will be moving to identify a public high school to engage in discussions about possible classroom activities and/or curriculum development, leveraging the newly-available sensor data to introduce students to the Internet of Things, and sharing the virtual reality product. Jayma Koval will lead this portion of the project's collaborative effort.

2.4.3. Virtual reality for community and K-12 engagement
We plan to document this project using virtual reality (VR) technology provided via a philanthropy program from Google, led by Lalith Polepeddi. We will use VR to transport viewers to Chatham County so that they can witness first-hand the impacts of sea level rise, hear from residents, local business leaders, and elected officials on the choices they're facing, and see how sea-level sensors help the community moving forward. With these stories, we hope to enable viewers who may not be familiar with other parts of Georgia to empathize with those impacted by climate change around the state, as well build excitement for solutions to the problems we all face together. The target audience for this communication piece includes both Chatham county residents as well as residents in other Georgia counties, from policymakers to

K-12 students. Towards that end, we are eager to engage with these audiences at the planning stages of our communication work to ensure that we will deliver a set of products that are most impactful for these partners. Community input will shape the final product through a series of discrete "screening" events for members of the greater Savannah area, with coordination and event space provided by Creative Coast (see supporting letter).

Appendix A   Letters of Support

CHATHAM COUNTY DEPARTMENT OF ENGINEERING

124 Bull Street, Room 430
P.O. Box 8161
Savannah, Georgia 31412-8161

Leon Davenport, P.E.
County Engineer

FAX 912-652-7818
912-652-7800

Suzanne Cooler, P.E.
Assistant County Engineer

April 30, 2018

To Whom It May Concern:

With this letter, the Chatham County Department of Engineering and Chatham Emergency Management Agency signal our collective intent to partner with the Sea Level Sensor research team from Georgia Institute of Technology, under the umbrella of the "Georgia Smart Community" program.

Coastal flooding and sea level rise represent a major risk to our coastal communities. Such risks are clearly visible during hurricane landfalls when extensive flooding exacts a major toll on public safety, livelihoods, and key infrastructure up and down the Georgia coast. The Chatham area needs high-quality data and associated tools to begin to plan for a future in which strategic investments will be required to minimize the risk of sea level rise from year to year and decade to decade.

The project underway with Georgia Tech researchers will provide sea level data from a network of LoRa-enabled sensors deployed at key points of vulnerability. We have identified the technology that will enable this work and are testing a prototype sensor with a bridge on Whitemarsh Island. We plan to deploy dozens more of these sensors at key points of vulnerability during this year-long project and explore additional uses for this sensor infrastructure. To ensure that the execution of the project delivers the most value to Chatham County, the following agency staff will be engaging with the Georgia Tech team to design and oversee the installation and use of the sensor network;

Leon Davenport – County Engineer
Billy Nicholson – Sr. Drainage Engineer
Kevin Hayes – Drainage Engineer
Kirk McElveen – GIS Analyst I
David Anderson – GIS Analyst II
Dennis Jones – Emergency Management Director
Randall Mathews – Emergency Management Coordinator

Chatham County will work to train relevant personnel on the maintenance of the sensor array and navigation of relevant software, with training provided by the Georgia Tech team. Taken together, these commitments reflect significant investments in the success of the project, and represent hardware acquisition and in-kind support of at least $25K.

Beyond the application to emergency planning and response, we are excited to partner with the Georgia Tech team to raise awareness about coastal flooding and sea level rise within the coastal community. In particular, we see immense value in the team's early ideas to design K-12 classroom curriculum modules that would leverage the data streams from the sensor networks. The fact that the Georgia Tech group already funded a project to visualize coastal flooding through its "Climate Stories" initiative, would greatly leverage our efforts in public outreach.

In summary, Chatham County is excited at the opportunity to partner with our counterparts in the City of Savannah, and scientists and engineers from Georgia Tech, in tackling one of the most pressing issues for our community. We are confident that our work together will provide a compelling template for future "Georgia Smart Communities" and very much hope to begin work as soon as possible. We are looking forward to hosting the research team in Savannah during May, when we can discuss project details in person.
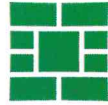
Please do not hesitate to reach out should you require further information.

Regards,

Leon Davenport, P.E.
County Engineer

May 1, 2018

RE: Letter of Support for Georgia Smart Community Program Grant – Savannah / Chatham County Sea Level Rise Data

To Whom It May Concern:

With this letter, the City of Savannah signals our collective intent to partner with the Sea Level Sensor research team from Georgia Institute of Technology, under the umbrella of the "Georgia Smart Community" program.

Coastal flooding and sea level rise represent a major risk to our coastal communities. Such risks are most clearly visible during hurricane landfalls, when extensive flooding exacts a major toll on public safety, livelihoods, and key infrastructure up and down the Georgia coast. Beyond that, as the City of Savannah needs high-quality data and associated tools to begin to plan for a future in which strategic investments will be required to minimize the risk of sea level rise from year to year and decade to decade.

The project that we hope to begin in earnest with Georgia Tech researchers would provide sea level data from a network of wifi-enabled sensors that we envision placing on key points of vulnerability during this year-long project. In order to ensure that the execution of the project delivers the most values to the City of Savannah, the following city staff will be engaging with the Georgia Tech team to assist the design and oversee the installation of the sensor network: David Donnelly, Emergency Manager; Tom McDonald, Flood Plain Manager; Nick Deffley, Sustainability Director. The City will work with the Georgia Teach Team to ensure relevant personnel are trained on the maintenance of the sensor array, and navigation of relevant software. Taken together, these commitments reflect significant investments in the success of the project, and represent in-kind support of at least $25K.
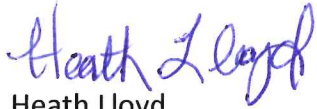
Beyond the application to emergency planning and response, we are excited to partner with the Georgia Tech team to raise awareness about coastal flooding and sea level rise within the Savannah community. In particular, we see immense value in the team's early ideas to design K-12 classroom curriculum modules that would leverage the data streams from the sensor networks. The fact that the Georgia Tech group already has a funded project to visualize coastal flooding through its "Climate Stories" initiative, would greatly leverage our efforts in public outreach.

In summary, the City of Savannah is excited at the opportunity to partner with our counterparts at CEMA, and scientists and engineers from Georgia Tech in tackling one of the most pressing

issues for our community. We are confident that our work together will provide a compelling template for future such "Georgia Smart Communities", and very much hope to begin work as soon as possible. Towards that end, we are looking forward to hosting the research team down in Savannah during May, when we can discuss project details in person.

Please do not hesitate to reach out should you require further information.

Sincerely,

Heath Lloyd
Chief Officer, Infrastructure & Development

Appendix B   Documentation of Financial Support

CHATHAM COUNTY DEPARTMENT OF ENGINEERING

124 Bull Street, Room 430
P.O. Box 8161
Savannah, Georgia 31412-8161
FAX 912-652-7818
912-652-7800

Leon Davenport, P.E.
County Engineer

Suzanne Cooler, P.E.
Assistant County Engineer

April 30, 2018

To Whom It May Concern:

With this letter, the Chatham County Department of Engineering and Chatham Emergency Management Agency signal our collective intent to partner with the Sea Level Sensor research team from Georgia Institute of Technology, under the umbrella of the "Georgia Smart Community" program.

Coastal flooding and sea level rise represent a major risk to our coastal communities. Such risks are clearly visible during hurricane landfalls when extensive flooding exacts a major toll on public safety, livelihoods, and key infrastructure up and down the Georgia coast. The Chatham area needs high-quality data and associated tools to begin to plan for a future in which strategic investments will be required to minimize the risk of sea level rise from year to year and decade to decade.

The project underway with Georgia Tech researchers will provide sea level data from a network of LoRa-enabled sensors deployed at key points of vulnerability. We have identified the technology that will enable this work and are testing a prototype sensor with a bridge on Whitemarsh Island. We plan to deploy dozens more of these sensors at key points of vulnerability during this year-long project and explore additional uses for this sensor infrastructure. To ensure that the execution of the project delivers the most value to Chatham County, the following agency staff will be engaging with the Georgia Tech team to design and oversee the installation and use of the sensor network;

Leon Davenport – County Engineer
Billy Nicholson – Sr. Drainage Engineer
Kevin Hayes – Drainage Engineer
Kirk McElveen – GIS Analyst I
David Anderson – GIS Analyst II
Dennis Jones – Emergency Management Director
Randall Mathews – Emergency Management Coordinator

Chatham County will work to train relevant personnel on the maintenance of the sensor array and navigation of relevant software, with training provided by the Georgia Tech team. Taken together, these commitments reflect significant investments in the success of the project, and represent hardware acquisition and in-kind support of at least $25K.

Beyond the application to emergency planning and response, we are excited to partner with the Georgia Tech team to raise awareness about coastal flooding and sea level rise within the coastal community. In particular, we see immense value in the team's early ideas to design K-12 classroom curriculum modules that would leverage the data streams from the sensor networks. The fact that the Georgia Tech group already funded a project to visualize coastal flooding through its "Climate Stories" initiative, would greatly leverage our efforts in public outreach.
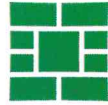
In summary, Chatham County is excited at the opportunity to partner with our counterparts in the City of Savannah, and scientists and engineers from Georgia Tech, in tackling one of the most pressing issues for our community. We are confident that our work together will provide a compelling template for future "Georgia Smart Communities" and very much hope to begin work as soon as possible. We are looking forward to hosting the research team in Savannah during May, when we can discuss project details in person.

Please do not hesitate to reach out should you require further information.

Regards,

Leon Davenport, P.E.
County Engineer

May 1, 2018

RE: Letter of Support for Georgia Smart Community Program Grant – Savannah / Chatham County Sea Level Rise Data

To Whom It May Concern:

With this letter, the City of Savannah signals our collective intent to partner with the Sea Level Sensor research team from Georgia Institute of Technology, under the umbrella of the "Georgia Smart Community" program.

Coastal flooding and sea level rise represent a major risk to our coastal communities. Such risks are most clearly visible during hurricane landfalls, when extensive flooding exacts a major toll on public safety, livelihoods, and key infrastructure up and down the Georgia coast. Beyond that, as the City of Savannah needs high-quality data and associated tools to begin to plan for a future in which strategic investments will be required to minimize the risk of sea level rise from year to year and decade to decade.

The project that we hope to begin in earnest with Georgia Tech researchers would provide sea level data from a network of wifi-enabled sensors that we envision placing on key points of vulnerability during this year-long project. In order to ensure that the execution of the project delivers the most values to the City of Savannah, the following city staff will be engaging with the Georgia Tech team to assist the design and oversee the installation of the sensor network: David Donnelly, Emergency Manager; Tom McDonald, Flood Plain Manager; Nick Deffley, Sustainability Director.   The City will work with the Georgia Teach Team to ensure relevant personnel are trained on the maintenance of the sensor array, and navigation of relevant software. Taken together, these commitments reflect significant investments in the success of the project, and represent in-kind support of at least $25K.
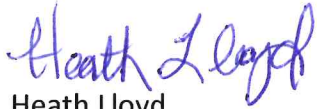
Beyond the application to emergency planning and response, we are excited to partner with the Georgia Tech team to raise awareness about coastal flooding and sea level rise within the Savannah community. In particular, we see immense value in the team's early ideas to design K-12 classroom curriculum modules that would leverage the data streams from the sensor networks. The fact that the Georgia Tech group already has a funded project to visualize coastal flooding through its "Climate Stories" initiative, would greatly leverage our efforts in public outreach.

In summary, the City of Savannah is excited at the opportunity to partner with our counterparts at CEMA, and scientists and engineers from Georgia Tech in tackling one of the most pressing

issues for our community. We are confident that our work together will provide a compelling template for future such "Georgia Smart Communities", and very much hope to begin work as soon as possible. Towards that end, we are looking forward to hosting the research team down in Savannah during May, when we can discuss project details in person.

Please do not hesitate to reach out should you require further information.

Sincerely,

Heath Lloyd
Chief Officer, Infrastructure & Development

Appendix C   Letters of Understanding from NGOs

To Whom It May Concern:

As the leading technology and innovation related organization in the greater Savannah area, we are thrilled to partner with the City of Savannah, CEMA, and Georgia Tech in the "Sea Level Sensor" project proposed for the Georgia Smart Communities Challenge. Specifically, we are excited about the opportunity to act as a co-convener for the proposed "Smart Sea Level" workshop. We have a number of candidate spaces, as well as access to a large network of tech-related businesses and other organizations to advertise the workshop and invite follow-on engagement with the project. We are also happy to leverage our web-based platforms to host and disseminate materials such as the Google virtual reality product to raise awareness about sea level rise and coastal flooding in Savannah.

As an organization that prides itself on delivering unique value to our community across the areas of sustainability, technology, equity, and education, the proposed project fits in well with our core mission. In turn, we recognize the near-term value of the project for the citizens of Savannah and beyond, as we collectively face a future of more frequent and more severe coastal flooding. Combining technology and awareness in service to capacity building is the key to a resilient, sustainable, equitable Savannah community that will thrive for decades to come.

Clinton Edminster
*Chairman,
Creative Coast Board of Directors*