**Scope of Work**

**Updating the Statewide Extreme Rainfall Projections**

Proposal to Florida Department of Business and Professional Regulation

Florida Building Commission

Sea Level Solutions Center (SLSC), Florida International University (FIU)

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In Collaboration With

Michelle Irizarry, Hydrologist, United States Geological Survey

Ana Carolina, District Resiliency Officer, South Florida Water Management District

Project Lead: Jayantha Obeysekera

1. **Introduction**

Local governments are starting to develop resiliency plans and are increasingly looking for projections of future changes in precipitation extremes to inform these plans. In Florida, this is even more important as frequency and strength of hurricanes/tropical storms are projected to increase causing excessive rainfall such as what was observed during Hurricanes Harvey, Florence, and Michael and Irma. The Southeast Florida Regional Climate Change Compact (<http://www.southeastfloridaclimatecompact.org/>) is an example of various counties joining forces to coordinate strategies for mitigation and adaptation across the southeast Florida region. However, the need for unified state-wide projections of precipitation extremes has become a critical missing piece for guiding future plans and building codes. Existing extreme rainfall information typically required for planning and design of infrastructure in Florida are dated and have not been updated for many decades. In absence of such extreme rainfall projections, state governmental agencies, individual municipalities and counties are making their own decisions on what data to use for planning, which range from simply using historically observed data to using large-scale global or regional predictions to inform future changes in extremes. This results in duplication of effort as well as inconsistent methodologies across planning boundaries.

Using funds provided by the Florida Department of Professional Regulation, FIU demonstrated the application of available modeling results to update the rain loads for the Florida Building Code (SLSC 2018). However, this study was limited to Miami Dade County and there have been some requests to conduct a similar study for all counties in the State of Florida. As a follow-up to recommendations made by a rainfall workshop last year at FIU, the South Florida Water Management District (SFWMD) will be collaborating with the United States Geological Survey to develop extreme rainfall estimates but only within its own boundary. The Sea Level Solutions Center (SLSC) will be an active collaborator in this effort. Leveraging the work of this collaboration, SLSC is now proposing its work for FBC in Miami Dade County to the entire state. This collaboration will ensure consistency and increase efficiency in technical efforts needed for the proposed project. Many of the team members have extensive experience in research on extreme rainfall that will be used in the propose research (Irizarry et al. 2016).

The Florida Building Code (FBC) is one of the strongest in the nation for protection from coastal hazards including wind and surge. Coastal communities are at risk of increasing flooding due to variation in rainfall extremes, sea-level rise, and rising water table exacerbating potential for flood damage to buildings. The proposed research will extend the successful outcomes of the Miami Dade study to all communities across the State of Florida. Once completed, it will be possible to update the extreme rainfall information for all communities across Florida.

1. **Relevant Sections of the Code**
2. Chapter 16 of the Florida Building Code: Structural Design; Section 1611, Rain Loads (Figure 1611.1); Plumbing figure 1106.1
3. Chapter 16 of the Florida Building Code: Structural Design; Section 1612, Flood Loads
4. Other Chapters of the Florida Building Code that may be affected by sea-level rise and changes to extreme rainfall.
5. **Scope of Work**

Extreme precipitation projections for durations and return periods relevant to the design of stormwater systems will be developed for future planning horizons, for example ~2030 (2010-2049) , ~2060 (2040-2079), or ~2070 (2050-2089) at NOAA Atlas 14 stations throughout the state of Florida. Rule 14-86 of the Florida Administrative Code (14-86.002) states that in determining critical storm duration, typical durations up through and including the 10-day duration should be considered for closed basins and up through the 3-day duration for basins with positive outlets. Water management districts in the state of Florida require 25- and 100-year return periods for design and permitting of stormwater systems. Stakeholders will be consulted early in the project timeline to determine if these or other durations and return periods would be most useful for their planning efforts.

* Statistically- and dynamically-downscaled precipitation data for the state of Florida will be obtained from the US Bureau of Reclamation’s BCCA (Bias-Corrected Constructed Analogues) product (Reclamation, 2013), the University of California-San Diego’s LOCA (Localized Constructed Analogues) product (Pierce et al., 2014), and the World Climate Research Program’s North America CORDEX (Coordinated Regional Climate Downscaling Experiment, with appropriate area reduction factors) product (Mearns et al., 2017). We will also consider another downscaling product. BCSA, developed by University of Florida for Tampa Bay Water (personal communication, Wendy Graham). Periods of interest for analysis include the historical period (1950-2010) and two future periods centered in ~2030 , ~2060 or ~2070.
* Annual maximum series (AMS) for durations of interest will be developed for historical and two future periods identified above at the grid points closest to NOAA Atlas 14 stations with a sufficiently long historical record. Depth-duration-frequency curves will be fitted to the AMS data using standard methods.
* Historical annual maximum series (AMS) of precipitation will be obtained from NOAA Atlas 14 volume 9 (NOAA, 2013) for stations within the state of Florida with a sufficiently long historical record. Depth-duration-frequency curves will be fitted to the AMS data using standard methods. The resulting DDF curves will be used in validation of downscaled historical precipitation extremes and bias-correction of projected precipitation extremes through quantile mapping methods. Quantile mapping methods could also be employed for temporal disaggregation of daily precipitation extremes into sub-daily timescales.
* Results will be summarized based on percentiles across models and Representative Concentration Pathways (RCPs). Results will be presented to stakeholders through a series of webinars. Stakeholders will be involved in the selection of future scenarios for planning.
* Maps of projected precipitation extremes for durations, return periods, and future periods of interest will be generated using GIS tools and posted online for public access. FIU will also developed statewide, web-based user interface for making extreme rainfall projections available to communities across the state.

1. **Method of Payment**

A purchase order will be issued to the Florida International University. This project shall start on the date of execution of the purchase order and end at midnight on August 31, 2021, and shall not exceed $137,124, and will cover all costs for labor, materials and overhead. Payment will be made for the study after the Contract Manager and the Florida Building Commission’s appropriate Technical Advisory Committee have approved the final report.

1. **Deliverables**
2. Assessment of the current rain loads and flood loads for various municipalities and recommendations for incorporating extreme rainfall into the code for all communities across the State
3. A final report extreme rainfall for the Florida Building Code
4. A technical workshop to review the results of the study and how floodplain management activities can be prioritized to accommodate any discrepancies between existing, planned and future flood elevations regulated by the Florida Building Code
5. Web-based, user interface for downloading extreme rainfall projections for any community across the state.
6. **Performance Measures and Financial Consequences**

SLSC at FIU is solely responsible for the satisfactory performance of the tasks and completion of the deliverables as described in this Scope of Work.

1. **Contract Manager**
2. **References**

Irizarry, M. M., Obeysekera, J., and Dessalegne, T. 2016. Determination of Future Intensity-Duration-Frequency Curves for Level of Service Planning Projects. Task 2 of SFWMD Purchase order 4500095433 – Deliverable 2.1. Conduct an extreme rainfall analysis in climate model outputs to determine temporal changes in IDF curves.

Sea Level Solutions Center (SLSC), Florida International University. 2018. Potential Implications of Sea-Level Rise and Changing Rainfall for Communities in Florida using Miami-Dade County as a Case Study, final report submitted to Florida Building Commission, Florida Department of Business and Professional Regulation

**9. Proposed Budget**

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| **Item** | **Budget Estimate** |
| FIU Salaries & Wages for PI and senior personnel (including fringe) | $61,500 |
| 1. Jayantha Obeysekera (Modeling, interim report, final report) |
| 2. Michael Sukop (Modeling, interim report, final report) |
| 3. Tiffany Troxler (Translation the results into Code, interim report, final report) |
| Statewide Rainfall Data Collection and QA/QC | $6,000 |
| FIU Support personnel and students for data collection, modeling, and assessment, Web Site Development | $26,100 |
| Total Direct Cost | $93,600 |
| FIU Indirect Costs | $43,524 |
| Total | $137,124 |