



EMERGENCY MANAGEMENT USE CASE

Research Title:	Flood Information and Response System (FIRST) for the City of Houston
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Description:	Flood Inundation and Response System (FIRST) is a radar-based flood hazard assessment and mapping tool developed for the City of Houston (COH). The system, in the form of a web dashboard (https://firstcoh.org/), displays real-time visualizations of rainfall intensity and estimated inundation (including flood depth, water surface elevation, and flood extent), updated every 15 minutes during severe storm events in four flood-prone urban watersheds in Houston, TX. FIRST provides the City with timely and relevant flood information, and could support the City's efforts in emergency management and / or operations, including road closures and evacuation protocols.
When Applied:	FIRST monitors rainfall intensity and provides real-time flood information (e.g., estimated flood hazard at selected critical infrastructures) during severe storms / flooding events. The system was developed in 2020 as a project for the City of Houston, and the web dashboard has been online and operational since 2021.
Who Applies:	FIRST was developed for the City of Houston (COH) to aid in their emergency management / operations. The information provided by FIRST however, could be useful to other local agencies / planners / developers / Houston residents as well.
Disaster Type:	Riverine flooding, urban flash floods and local (pluvial) flooding
Infrastructure Affected:	FIRST is focused on selected critical facilities / infrastructure (hospitals, nursing homes, public schools, fire stations and storm shelters), but could provide relevant flood hazard information to other residential / commercial / public / governmental properties within the study areas.
Industry Affected:	<ul style="list-style-type: none"> Governmental (COH Public Works, Health Department, etc.) Other potential stakeholders: TXDOT, Houston Transtar, Harris County Flood Control District (HCFCD)
Where Applied:	Four flood-prone urban watersheds in Harris County, TX: Brays Bayou, White Oak Bayou, Hunting Bayou, and Sims Bayou. The system could potentially be expanded to other watersheds in the Greater Houston region.
Agency Affected:	FIRST was developed for the City of Houston (COH) to aid in their emergency management / operations.
VOAD Affected:	No
Who/What Affected:	City of Houston, Houston residents
How Affected:	<ul style="list-style-type: none"> City of Houston: having real-time, accurate, relevant flood information to support emergency management and resource prioritization



	<ul style="list-style-type: none"> Houston residents: better understanding of local flood risks / hazard, promote / encourage situational awareness during severe storms / flood events
Timing of Application:	FIRST displays relevant flood information on a web dashboard in real time prior to, during, and after severe storm events.
Critical Points:	<ul style="list-style-type: none"> Having reliable real-time distributed (radar) rainfall data as system input / trigger. Having calibrated and validated hydrologic / hydraulic models to generate flood hazard maps for the studied watersheds. Having accurate information on selected critical facilities / areas of interest. Having sufficient online storage and network connection (primary and backup) to ensure uninterrupted system operation. Having trained / knowledgeable personnel to monitor and act upon the information provided by the system.
What Benefit:	Provide relevant and timely flood related information to support emergency management / operations, design / optimize flood mitigation strategies, and plan for future flood resilience / development.
Where Used:	Similar methodologies have been applied at Brays Bayou watershed in Houston, TX: Flood Alert System 5 (http://fas5.org/home.html) for the Texas Medical Center and Opensafe Mobility (https://www.opensafemobility.com/). Also, Harris County Flood Control District (HCFCD) has its Harris County Flood Warning System (https://www.harriscountyfws.org/) that displays real-time gage rainfall and streamflow measurements for watersheds within its jurisdiction.
Additional Research:	<p>While research for the original scope of work for FIRST has been completed, with the system and web dashboard being online and operational since 2021, the system would benefit from additional research in these areas:</p> <ul style="list-style-type: none"> more testing / validation from more storms to ensure system reliability and robustness, linking the system to traffic cameras or traffic network (TXDOT, Google Traffic, or Houston Transtar) for more information on road conditions during flood events leveraging social media data and 311 calls to provide additional information on flooding occurrences. <p>Also, additional research would be required if the stakeholder decided to expand the system domain to include other urban watersheds in the region.</p>
Additional Information:	SSPEED website (https://www.sspeed.rice.edu/watersheds)
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Original Research:	FIRST web dashboard (https://firstcoh.org/)
What Risks:	Risks from usage / adoption should be minimal, since the data inputted into the system (e.g., radar rainfall) were from publicly available sources,



	and hydrologic / hydraulic models used had been calibrated and/or validated. However, the system could still over or underestimate inundation for the studied areas, therefore periodic testing / validation of the system would be required to maintain as well as improve system performance. Also, a disclaimer would be necessary to state the system is meant for informational purposes only to prevent any liability issues.
Partner Agencies/Jurisdictions:	City of Houston. Other potential partners: HCFCD, TXDOT, Houston Transtar
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Research with a Technology Component Should Respond to the Following Questions

Research Requested:	Develop a web dashboard that presents relevant and timely flood information during severe storms for the City of Houston.
Why Better:	FIRST provides reliable real-time rainfall and flood hazard estimates (flood depth and extent) for areas of interest / critical facilities in a simple and user-friendly interface, which is useful for quick decision making and emergency management. For the general public, it could help with flood risk communication and encourage situational awareness during severe storms / flood events.
Reliability:	FIRST uses rainfall data obtained from the NWS, hydrologic / hydraulic models are calibrated / validated for the studied watersheds. Online cloud storage is set up to ensure uninterrupted operation.
Support Needed:	<ul style="list-style-type: none">• Uninterrupted network and online storage• Consider adding / placing cameras at flooding hotspots for additional flood monitoring and model / system validation.• Personnel to monitor, operate, and maintain the system
Citizen Impact:	There should not be any adverse impact on the public or individuals from the adoption of the system.
Training Required:	Annual training workshops to train emergency managers / personnel on how to use / operate the system.
Public Accountability:	FIRST should not raise any privacy issues since input data were obtained from publicly available sources but would need a disclaimer stating that the system was meant for informational purposes only.

Please Note: Questions or suggestions regarding the Use Case Template may be directed to Dr. MacGregor Stephenson at the Texas Division of Emergency Management at macgregor.stephenson@tdem.texas.gov.