Hurricane Harvey in Houston

Mu-Chien Ko, Lauren Lotenfoe, Joshua Darville, Terry Durrant, Michael Caballero
As the threats of severe weather and the effects of climate change become more prevalent, a collaborative approach is put toward protection of people, property, and land. Using the devastation of Hurricane Harvey as an example, we will analyze the emergency response, recovery, preparedness, and mitigation of the city of Houston. Our analysis concludes that there is a need for greater emphasis on Emergency planning and risk mapping. We used the Geographic Information System (GIS) mapping system to help analyze, measure and quantify portions of the physical risk and mitigation solutions. For this study, the focus is on analysis of Risk mapping and the Emergency response in the aftermath of the Hurricane.
Step 1 - Response
What was the emergency response

Step 2 - Recovery
What changed for Houston in the aftermath of the hurricane

Step 3 - Plan
How did they update their Emergency plan/ response

Step 4 - Mitigate
How to implement Harvey’s data for making better decision in the future

Hurricane Harvey
Background- Hurricane Harvey Flooding

- Category 4 hurricane
- Made landfall on Aug. 25, 2017
- Stalled over Texas for 5 Days
- 103 Direct and Indirect deaths
- Estimated $150-200 billion in damage
- Second-most costly hurricane to hit the U.S. mainland since 1900
Response

- **Historic Response included:**
  - Neighbors
  - Strangers
  - Nonprofit organizations
  - Governments at all levels
- The Federal Emergency Management Agency (FEMA) pre-positioned supplies and personnel in the state before the storm made landfall
- **Major disaster declaration issued immediately:**
  - Allowed dozens of federal agencies to assign personnel to support the State of Texas
  - Over 31,000 Personnel deployed from:
    - FEMA
    - National Guard
    - Other Federal agencies
Response

Coast Guard

Civil Air Patrol

Department of Energy

Department of Transportation

National Weather Service

Department of Housing & Urban Development

Environmental Protection Agency

Department of Defense

Department of Health & Human Services

Centers for Medicare and Medicaid

FEMA

U.S. Army Corps of Engineers

300 Volunteers Organizations

American Red Cross

Texas Workforce Commission

General Services Administration
Response

- **Mobilized Assets:**
  - 83 Aircraft
  - 75 Boats
  - 29 Cutters
  - 28 Urban Search and Rescue Teams

- **Emergency Efforts:**
  - 122,331 People Rescued
  - 5,234 Pets Rescued
  - 1.5 Billion in Emergency Aid

- **Supplies Distributed:**
  - 3 Million Meals
  - 3 Million Bottles of Water
  - 9,900 Blankets
  - 480 cots
  - 10,300 Hygiene Kits
  - 210,000 Lbs of Hay for Livestock
  - 25 Tons of Pet Food
Response

- 5,359 Medical Patients Cared
- 24 Hospitals Evacuated
- 23 Ports Closed
- 780,000 Texans Evacuated
- 42,000 Texans Housed in 692 Shelters
Recovery

- 87,000 Flood Insurance Claims
- 608,000 Flood Insurance Advances
- 367 Million Low Interest SBA Loans
- 792,000 households applied for assistance
- More than $1.5 billion in federal funds was paid to Texans impacted by the disaster
- 270,916 Texas households were provided $571.8 million from FEMA for temporary housing
- Three years later and 20% of those that applied for temporary housing are still in it
Recovery

1. **FEMA Damage Assessment**
   The damage assessment is used to inform policy and keep other organizations abreast.

2. **Property Claims**
   National Insurance activates and transfer risk from the major of the population.
What changed in Houston after Hurricane Harvey

- Revisions to Harris County’s Floodplain Regulations
- Updates to Chapter 19 of the City of Houston Code of Ordinances
- The City of Houston Adopts Recommendations from the Redevelopment and Drainage Task Force
- Houston Public Works Made Significant Changes to its Detention Requirements
- Hurricane Harvey Flood Mitigation and Restoration Projects
- FEMA Changed Flood Hazard Area based on Harvey’s Flooding
Plan & Prepare: Hazard & Vulnerabilities

- Harris County Flood Warning System shows the current and historical rainfall, inundation, and channel status: https://www.harriscountyfws.org

Accumulated Rainfall during Harvey

Floods and channel status during Harvey
Mitigate: Risk Mapping

Harris County Elevation Map

Hurricane Harvey Rainfall

Harris Land Cover Map

Flow chart picture for risk mapping
Mitigate: Risk Mapping

Harris County Flood Risk Map

- Identify high risk area with the rainfall data as input
- Very high risk areas align with the evacuation zone
- High risk areas are mostly the heavy flood zone
Mitigate: Identify Vulnerabilities

1. List of proxies for potential high risk groups
2. Assigning Weights for additional shelter mapping (e.g., high weight for households without cars)
Mitigate: Shelter Mapping

Possible Additional Shelter locations

- Utilize the high vulnerability data and the existing shelter location to identify potential additional shelters
- Higher weight goes to household without vehicles
References

- https://www.worldvision.org/disaster-relief-news-stories/2017-hurricane-harvey-facts
- https://www.jems.com/operations/preparing-for-catastrophe/
- https://www.gislounge.com/how-to-use-arcgis-pro-to-map-flood-susceptibility/