Hurricane Harvey Hazard Risk Index

JESSICA LI

GIS SPECIALIST |SFU FACILITIES SERVICES

GIS day

Agenda

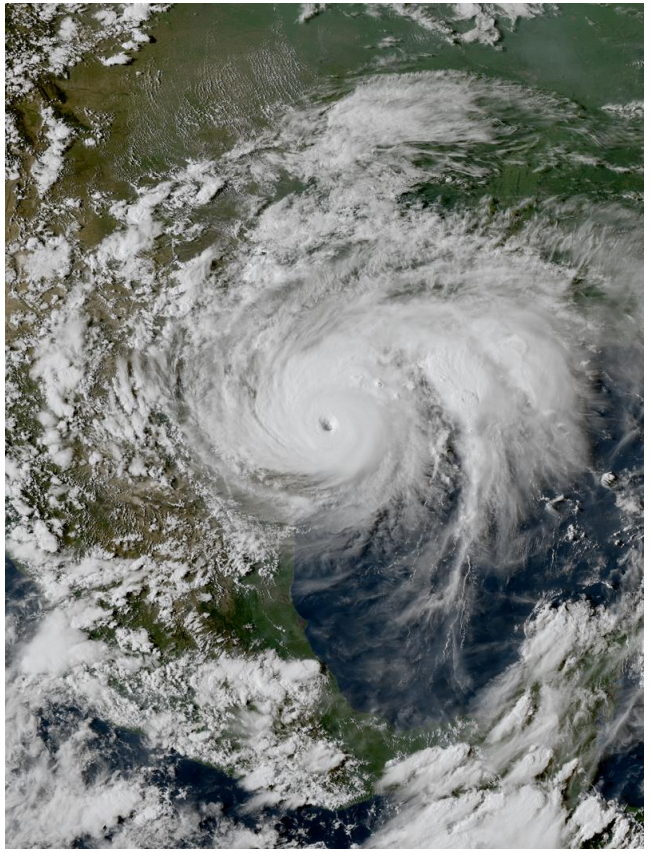
1. Project Background
2. Project Objectives and Deliverables
3. Project Data
4. Methodology & Workflow
5. Project Results

Project Introduction

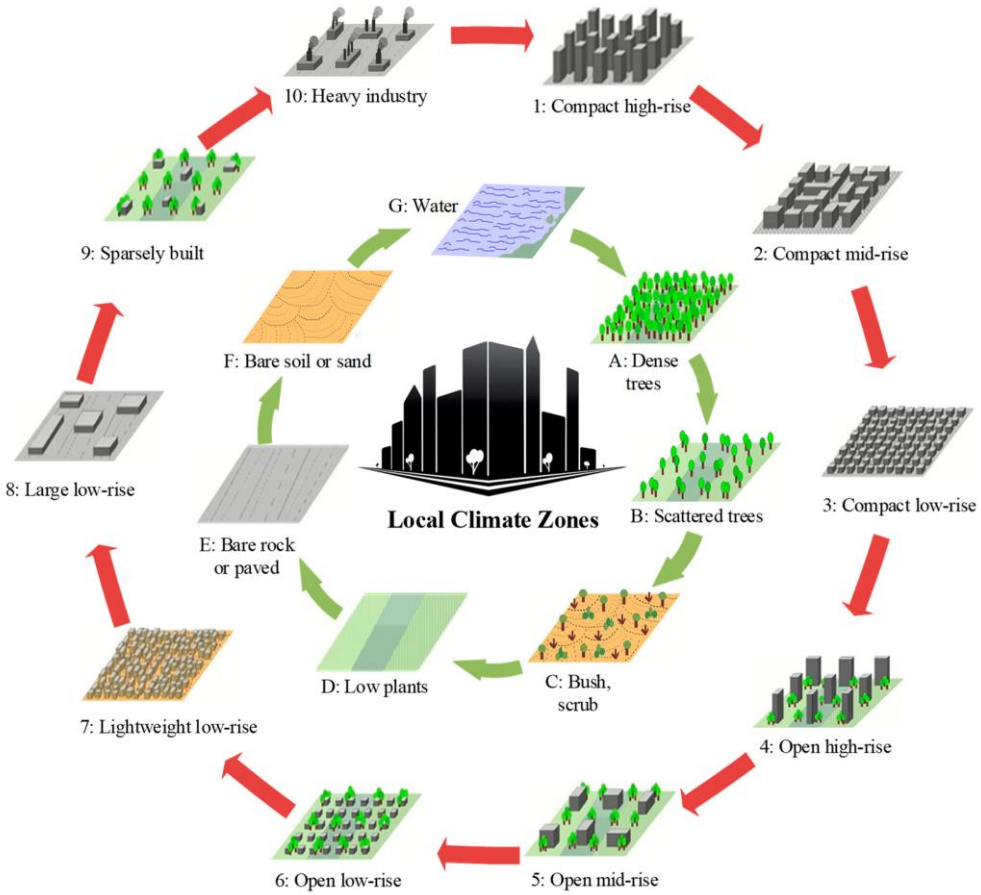
- Project Topic: Natural Hazard
- Project Statement:

This project aim to help geo-science researchers to investigate if the Local Climate Zone Urban Classification Scheme is suitable for simulating hurricane events by using GIS to identify high risk regions in the case study of Hurricane Harvey.

Project Background



The Local Climate Zone Classification Scheme



A comprehensive and micro level land use classification system

Local Climate Zones (LCZ) offer a climate-aware and standardized classification scheme composed of 17 urban and natural landscape classes.

Project Objectives

1. To integrate weather data for spatial analysis
2. To create Hurricane Harvey Risk Index Map
3. To explore the spatial relationships among hazards, exposure, and social vulnerability index

Deliverables

1. A map of hazard – Hurricane Harvey's flooding coverage, flood depth, and cumulative rainfall in Houston
2. A map of exposure - number of homes, percentage of mobile homes, population density, and distance to the closest river in Houston
3. A map of vulnerability – demography and public health data in Houston
4. A map of Hurricane Harvey Risk Index
5. A set of spatial analysis output data

Project Data

Dataset	Type	Data Format
Flood	Image	Raster
Rain	Image	Raster
Environmental Justice index	Polygon	Shapefile
Social Vulnerability index	Polygon	Shapefile
Shelter	Point	Shapefile
River	Polyline	Shapefile
Huston Census Tract	Polygon	Shapefile

Methodology

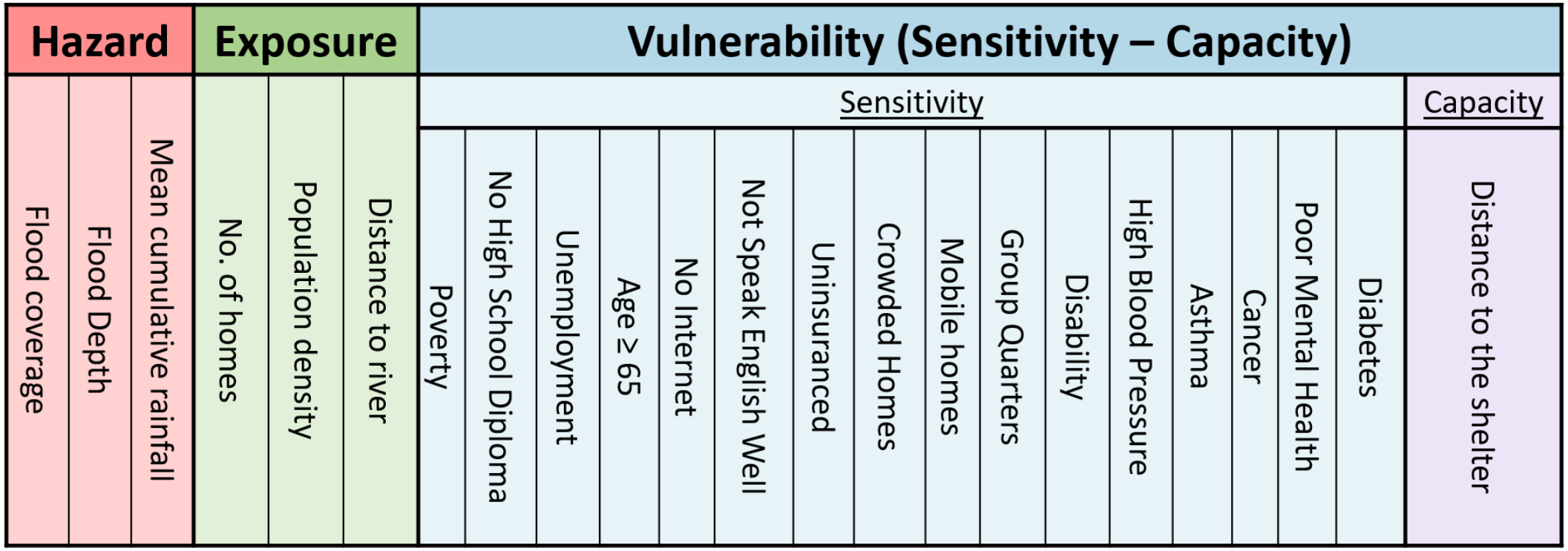
Three themes (**Hazard**, **Exposure, Vulnerability**)

Altogether 23 factors were considered (**Hazard**: 3, **Exposure**: 3, **Vulnerability**: 16 (sensitivity) , 1 (capacity))

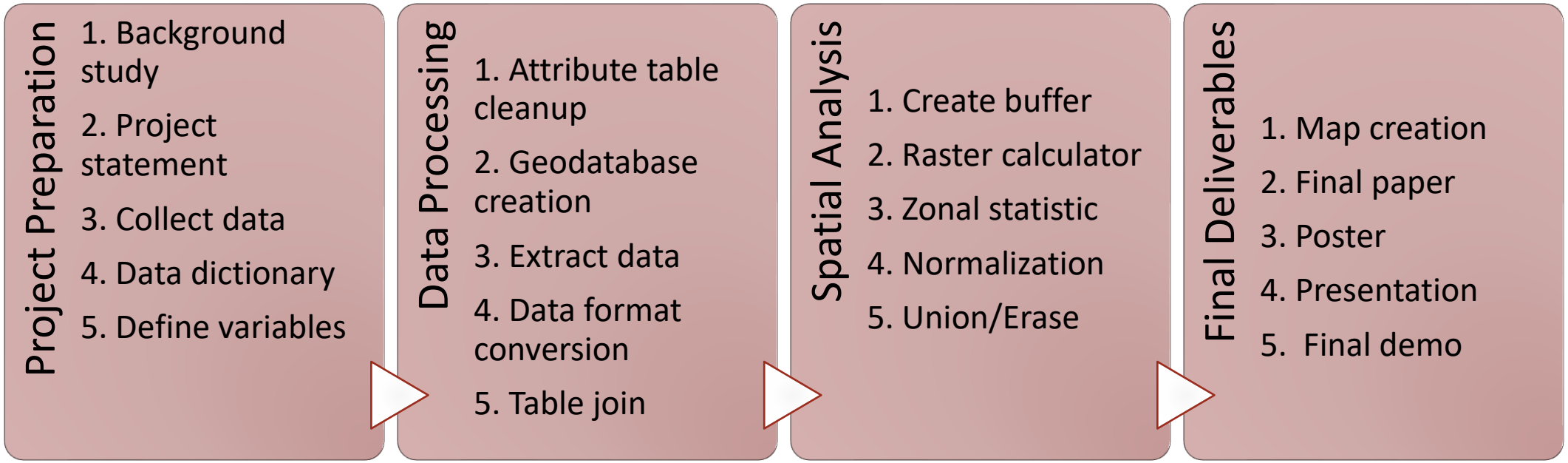
Risk = (Hazard + Exposure + Vulnerability)/3

Vulnerability = Sensitivity – Adaptive Capacity

Vulnerability Definition



Workflow

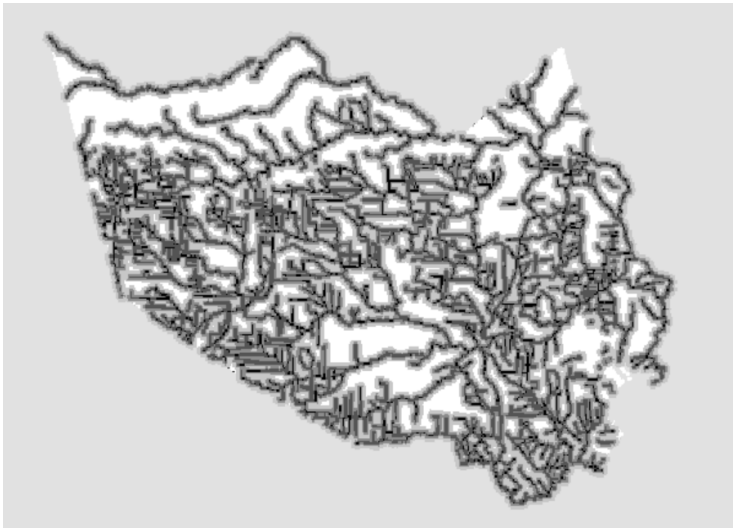

Project Preparation
1. Background study
2. Project statement
3. Collect data
4. Data dictionary
5. Define variables
Data Processing
1. Attribute table cleanup
2. Geodatabase creation
3. Extract data
4. Data format conversion
5. Table join
Spatial Analysis
1. Create buffer
2. Raster calculator
3. Zonal statistic
4. Normalization
5. Union/Erase
Final Deliverables
1. Map creation
2. Final paper
3. Poster
4. Presentation
5. Final demo

Exposure		Hazard		Vulnerability	
Population Density	Attribute Table Calculate Geometry Field Calculation Normalization Feature to Raster	Flood Depth	Raster Clip Tool Raster Calculator Normalization	Capacity	Create buffer Erase Union Feature to Raster
Home Density		Mean Cumulative Rainfall		16 Sensitivity	Extract from SVI & EJI layers Feature to Raster Raster Calculator
River Distance	Create buffer Union Erase Feature to Raster	Flood Coverage	Attribute table Field Calculation Normalization Feature to Raster		

Exposure =
(Population Density + Home Density + River Distance) / 3

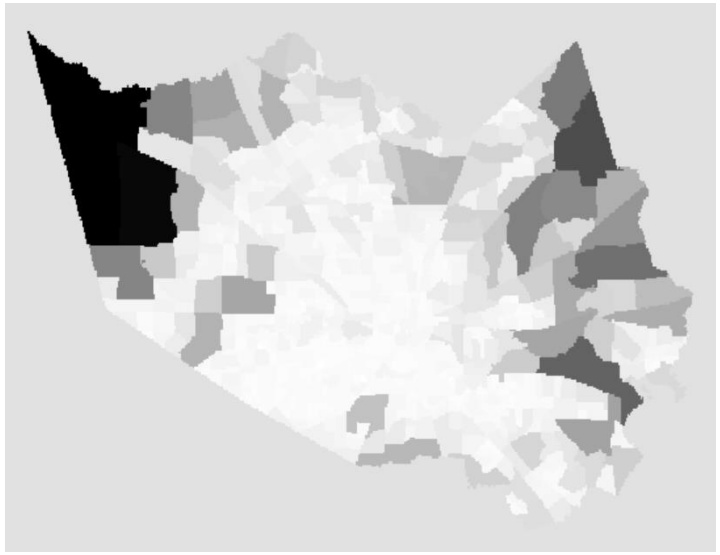
Population Density (Normalized)

Home Density (Normalized)

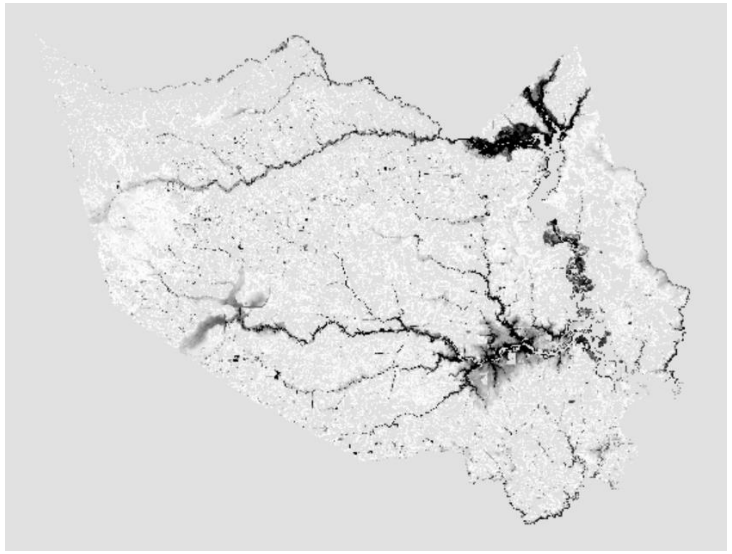


River Distance

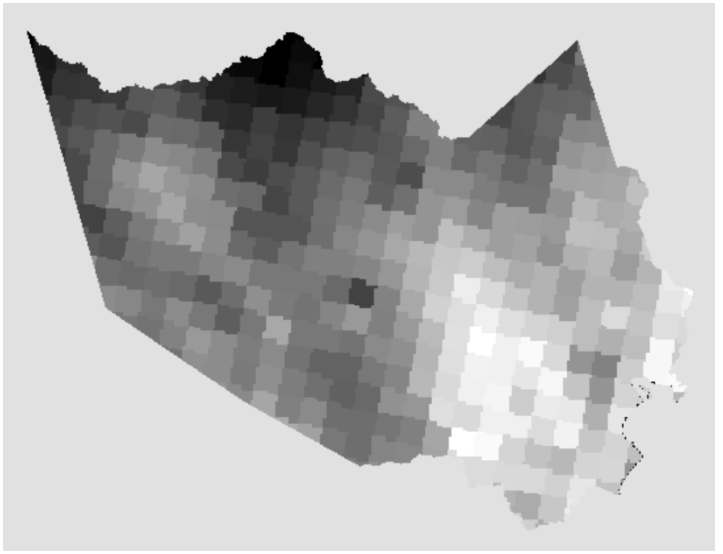
Hazard =
(Flood Coverage + Flood Depth + Mean Cumulative Rainfall)/3



Flood Coverage (Normalized)

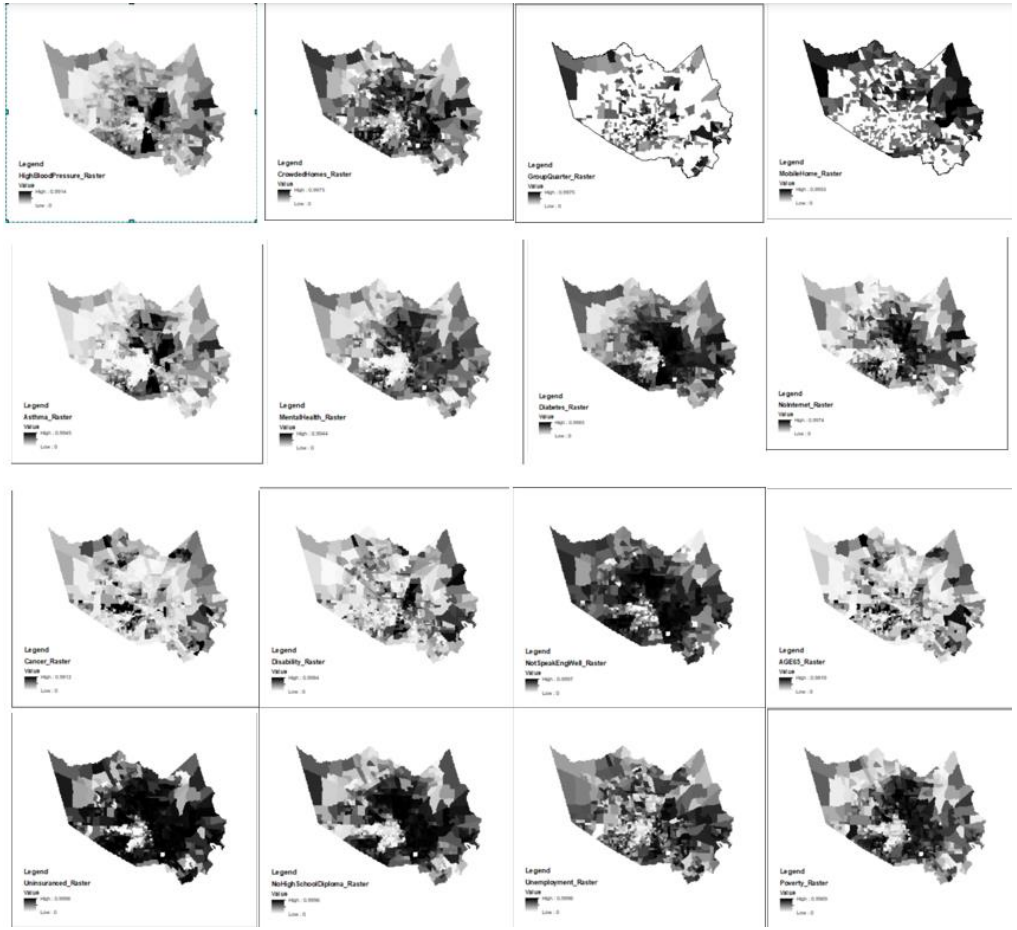


Flood Depth (Normalized)



Mean Cumulative Rainfall (Normalized)

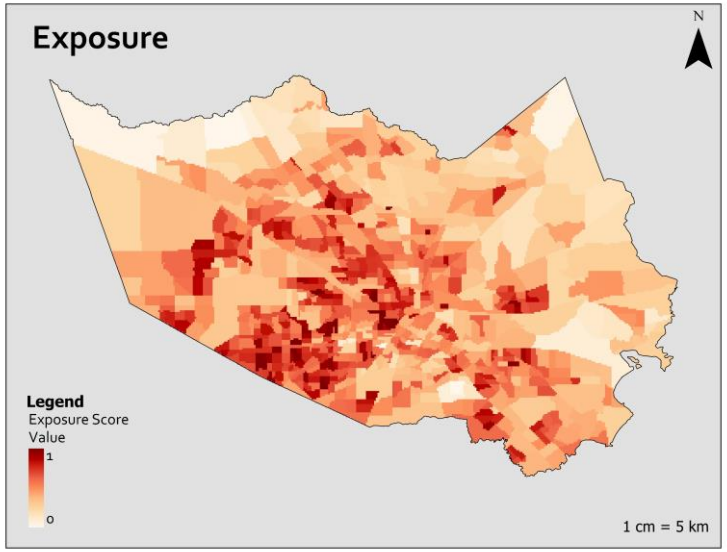
Vulnerability = Sensitivity– (Capacity * 0.1)

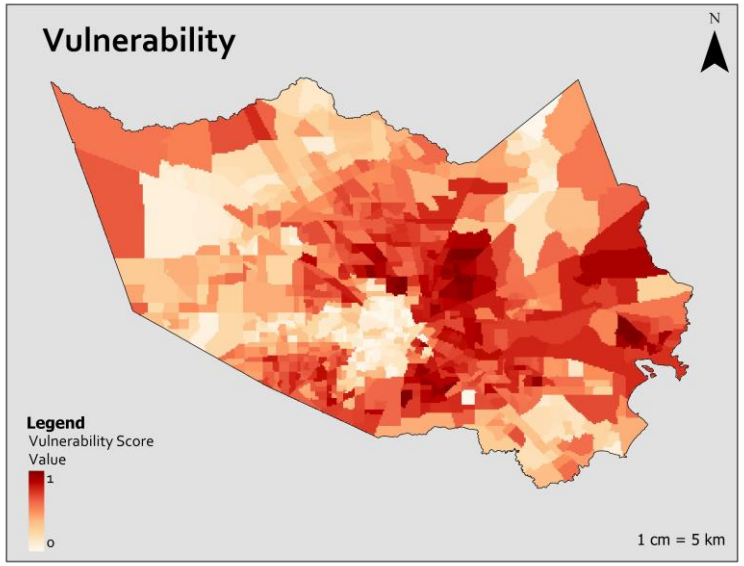


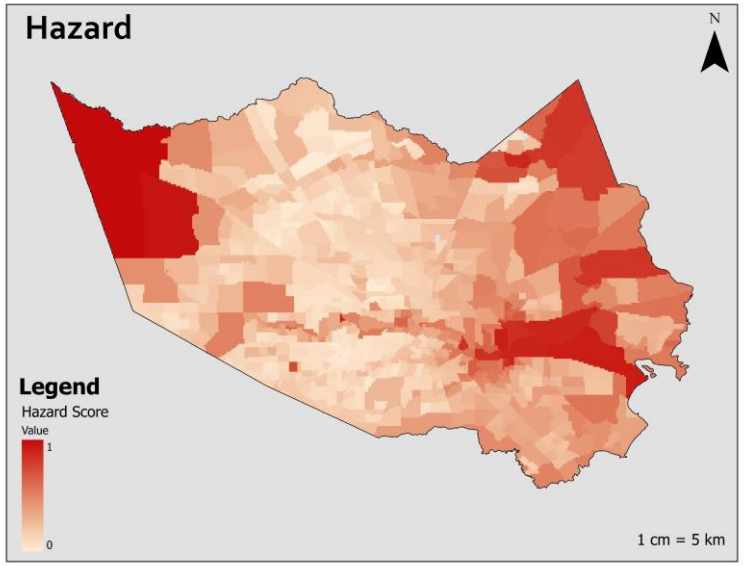
Sensitivity

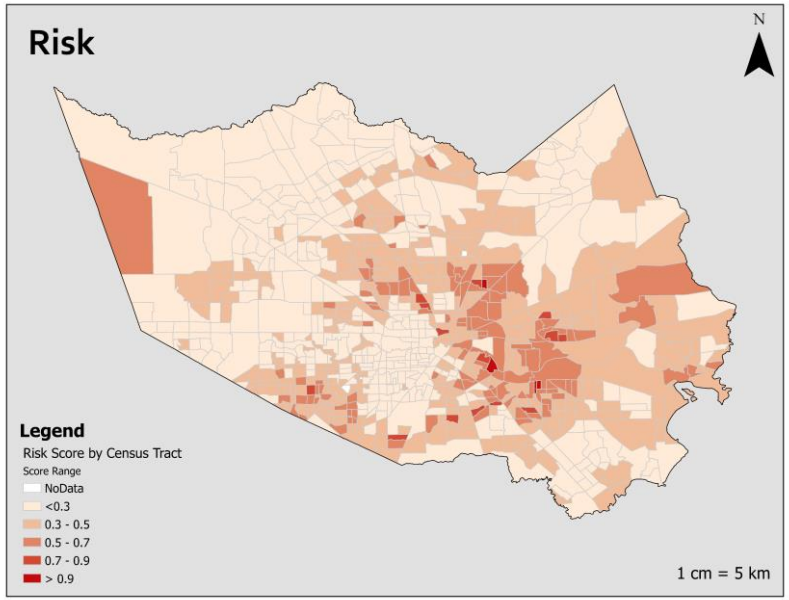
Vulnerability = Sensitivity– (Capacity * 0.1)

Capacity = Shelter Distance

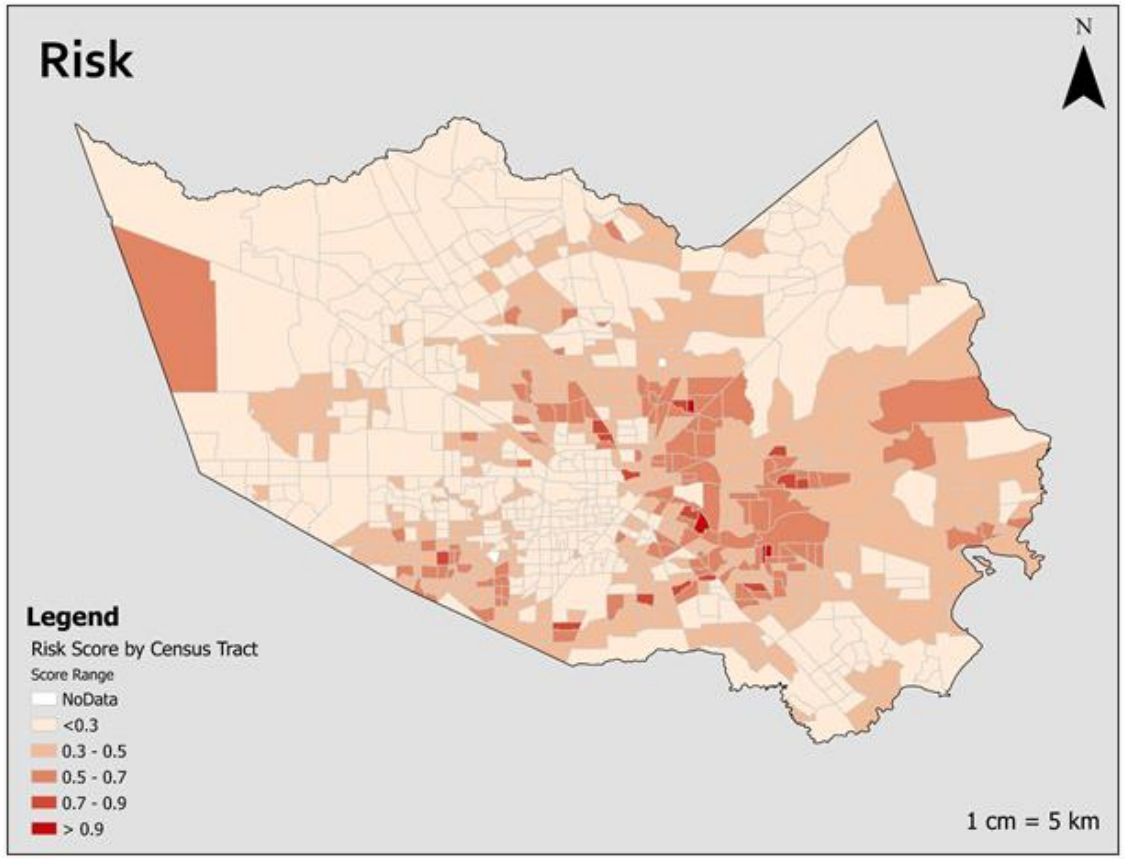

Exposure
N
Legend
Exposure Score
Value
1
0
1 cm = 5 km

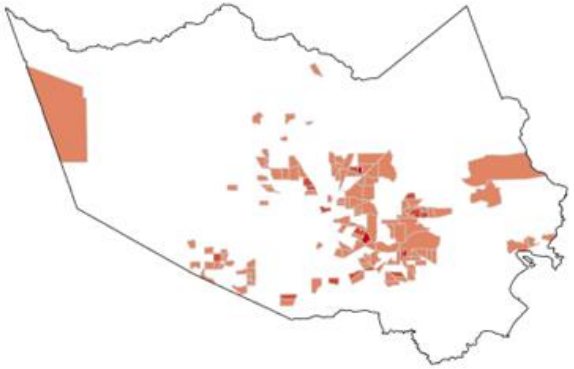

Vulnerability
N
Legend
Vulnerability Score
Value
1
0
1 cm = 5 km


Hazard
N
Legend
Hazard Score
Value
1
0
1 cm = 5 km


Risk
N
Legend
Risk Score by Census Tract
Score Range
NoData
<0.3
0.3 - 0.5
0.5 - 0.7
0.7 - 0.9
> 0.9
1 cm = 5 km

Project Results





The result is very close to expectations

- Local Climate Zone Urban Classification Scheme is able to simulating hurricane events
- High risk neighborhoods are able to identify

Spatial awareness and visualization are the two main highlights that make GIS a powerful tool in disaster management and mitigation planning.

Thank you!

SFU Facilities Services Mapping Platform:
https://viewsfu.its.sfu.ca/apps/vertisee/public/