

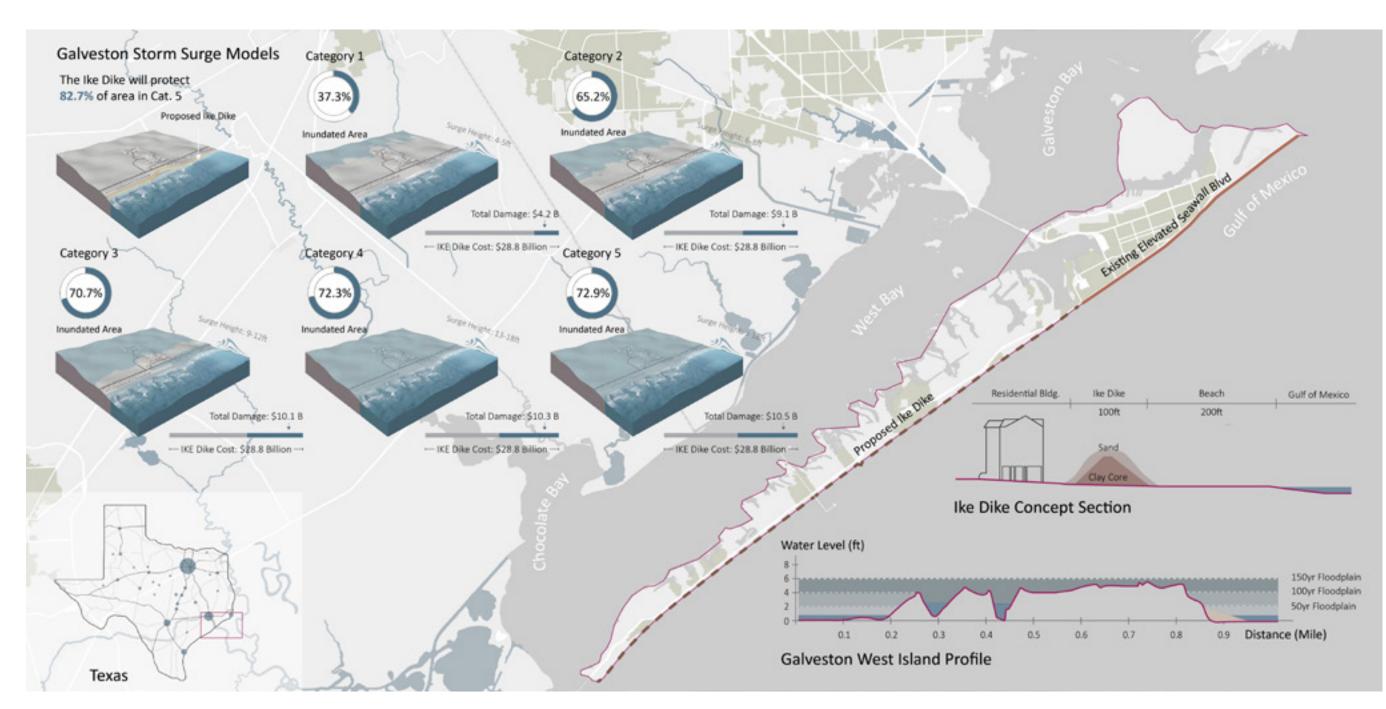
# Assessing Galveston Future Flood Risk Combining Landscape Performance and Land Prediction Models Zhenhang Cai, Drs. Galen Newman, Xinyue Ye, David Retchless, Lei Zou, and Youngjib Ham

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#### Introduction

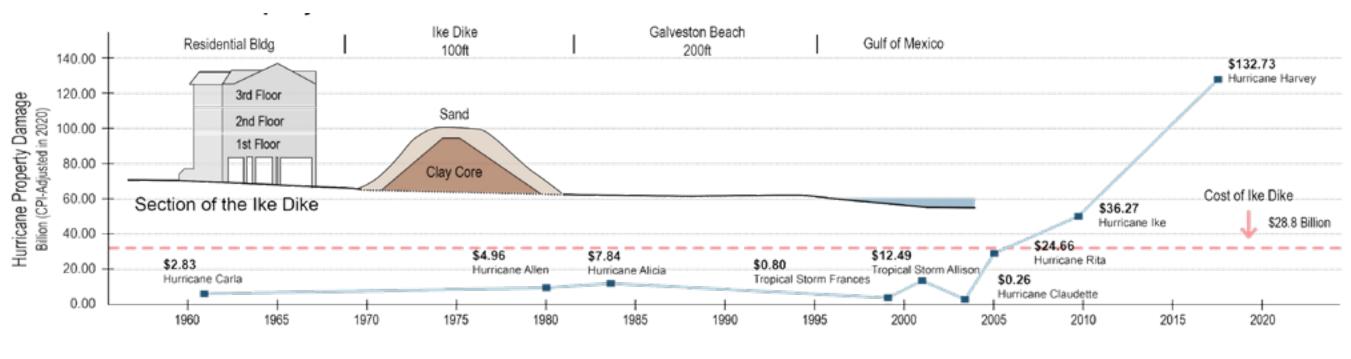
Study Area: Galveston Island, Texas, USA

**Characteristics: Barrier island** of Houston-Galveston area, has suffered from hurricanes and coastal flooding for a long time due to flat topography and coastal adjacency but supports large population and economy.



**Increasing property loss** especially in recent three decades, are even more than the estimated cost of Ike Dike (\$28.8 Billion in US Dollars). By storm surge simulation result, the lke Dike will protect 82.7% area in Category 5, and **\$10.5 Billion property values** across 1 to 5 categories.

Galveston County Property Loss\* CPI Adjustment to 2021 in US Dollars



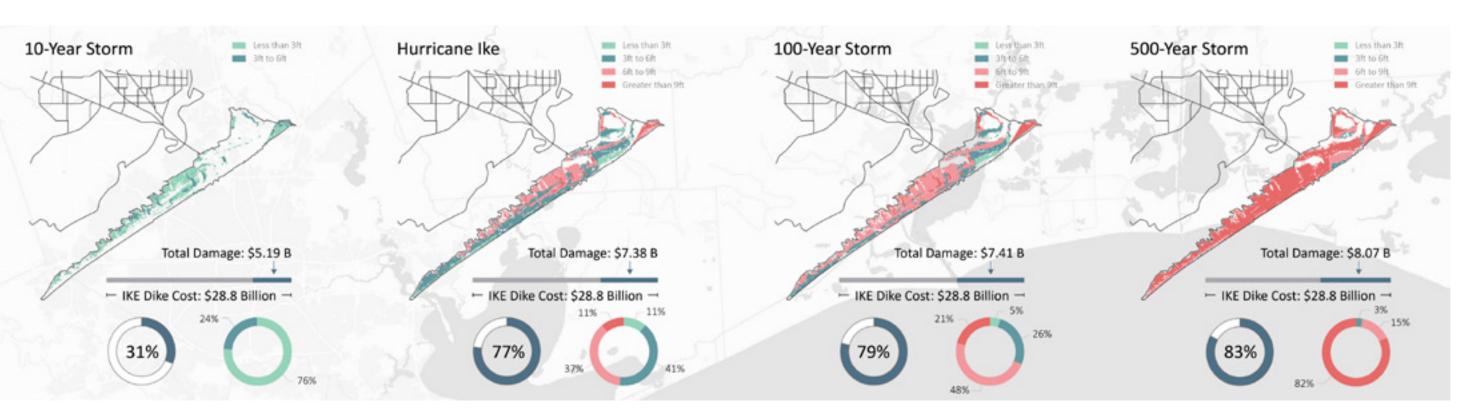
# Workflow & Method

#### Landscape Performance Model Land Prediction Model Urban Context • Vegetations Street Network 3D Basemap City Engine • 10yr-Storm No Dike Vacant Prediction Hurricane Ike No Dike Dyna-CLUE • 100yr-Storm No Dike The Conversion of Land • 500yr-Storm No Dike Use and its Effects • 10yr-Storm w/ Dike No SLR Hurricane Ike w/ Dike • 100vr-Storm w/ Dike • 500yr-Storm w/ Dike • Dike Performance • 10yr-Storm No Dike ArcGIS Pro Flood Impact Analysis Hurricane Ike No Dike • 100yr-Storm No Dike **Buyout Priority** • 500yr-Storm No Dike Criteria 1: located within w/ 2.4ft SLR • 10yr-Storm w/ Dike 100yr or 500yr floodplain Hurricane Ike w/ Dike Criteria 2: Inundation depth in Hurricane Ike or Harvey 100yr-Storm w/ Dike (<3', 3 to 6', 6 to 9', and >9') • 500yr-Storm w/ Dike Physio-economi Urban Analytics LU Impact Socio-economic Bldg Impact Analysis **ArcGIS Pro L-THIA Basic** L-THIA-LID Model How well will the Ike Dike protect How to increase Galveston Island across multiple flood resilience for storm scenarios, with the current Galveston County? sea level and a predicted 2.4ft SLR?

# **Dike Performance**

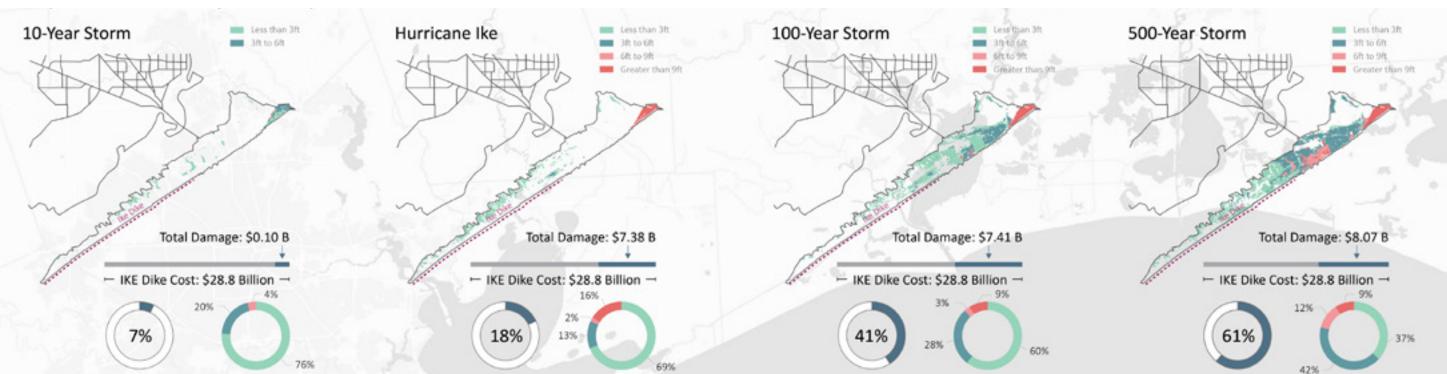
## 1. No lke Dike

- No scenario's damage is more than the cost of the lke Dike
- Even a **10-year storm** can flood **nearly 1/3** of the island
- Inundation level increases significantly in 500-year storm
- Considering multiple storms, the dike cost outweighs damage impacts



### 2. With the lke Dike

- Average 36% decrease in inundated area per storm (lke scneario ~60%)
- \$15.14 Billion decrease in inundated property value across all storms
- (\$4 Billion decrease on average per scenario)
- 22.5% Avg. decrease in 9ft inundation



# 3. Bldg Impact Analysis - Hurricane Ike Scenario

- Inundation depth will decrease 2.91ft (from 6.39ft to 3.48ft)
- 12170 buildings (90.0%) and 820.03 acres less inundated
- 12870 buildings (95.4%) and 882.67 acres less inundated in **inundation** category - greater than 91



# 4. Bldg Impact Analysis - Hurricane Ike plus 2.4ft SLR Scenario

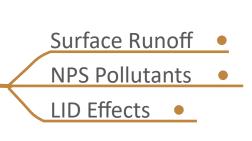
- Inundation depth will decrease 2.58ft (from 8.67ft to 3.81ft)
- 6228 buildings (25.3%) and 414.11 acres less inundated
- 24058 buildings (97.6%) and 1643.12 acres less inundated in **inundation** category - greater than 9



The lke Dike won't protect the area unless a full ring created and its effect diminishes in larger scale storms and SLR.



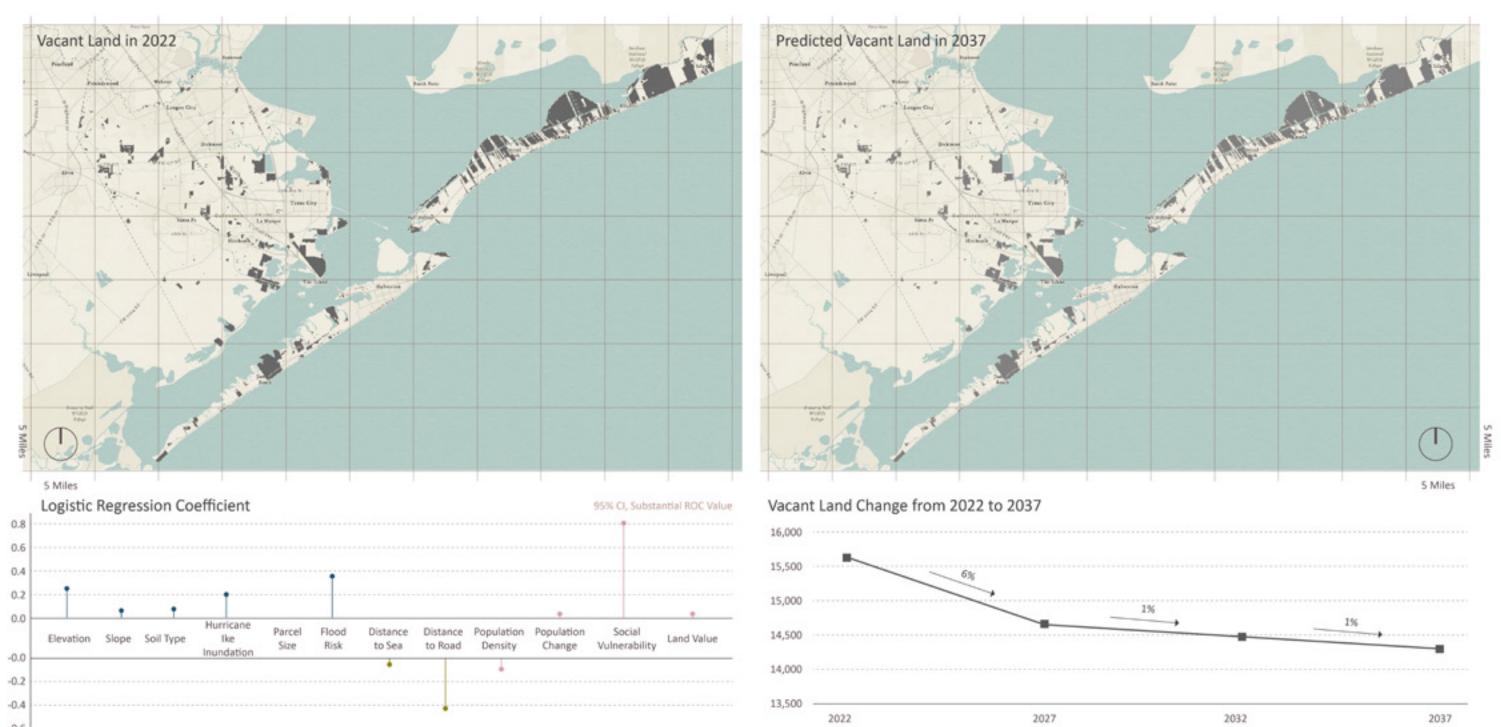
4- Medium to High 🔸 5- High 🔸



How can Galveston County increase its flood resilience through incorporating non-structural strategies such as vacant land buyout policies?

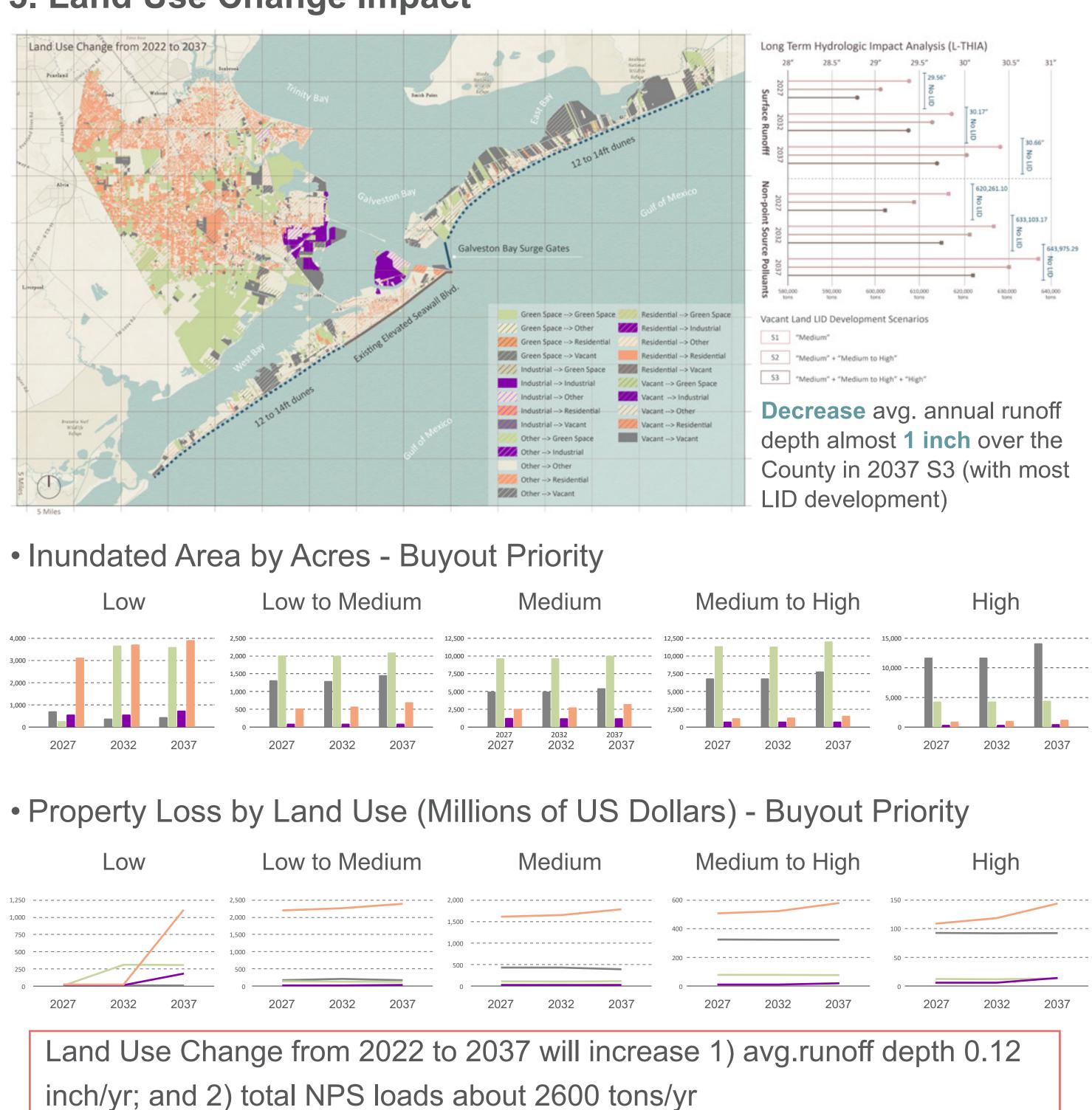
# Land Use Change Impact

## **1. Vacant Land Prediction in CLUEs**



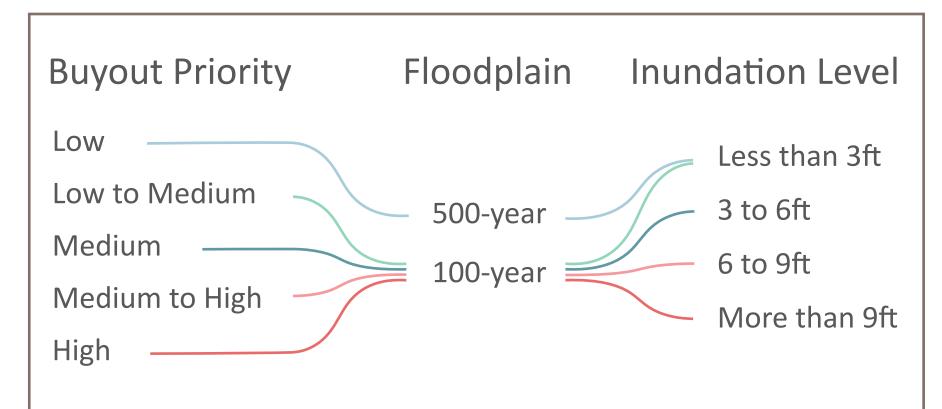
### 2. Buyout Priority defined by Inundation Risk System

- More vacant land will get inundated as inundation risk increases
- In Buyout Priority 4 and 5, most land use are green space and vacant land, with limited industrial and residential



#### **3. Land Use Change Impact**

4,000			2,500		
3,000			2,000		
2,000 ·			1,500		
			1,000		-
1,000 ·			500		
0			0		
2027	2032	2037	2027	2032	20
• Property Loss by Land Llss					



Buyout Priority System