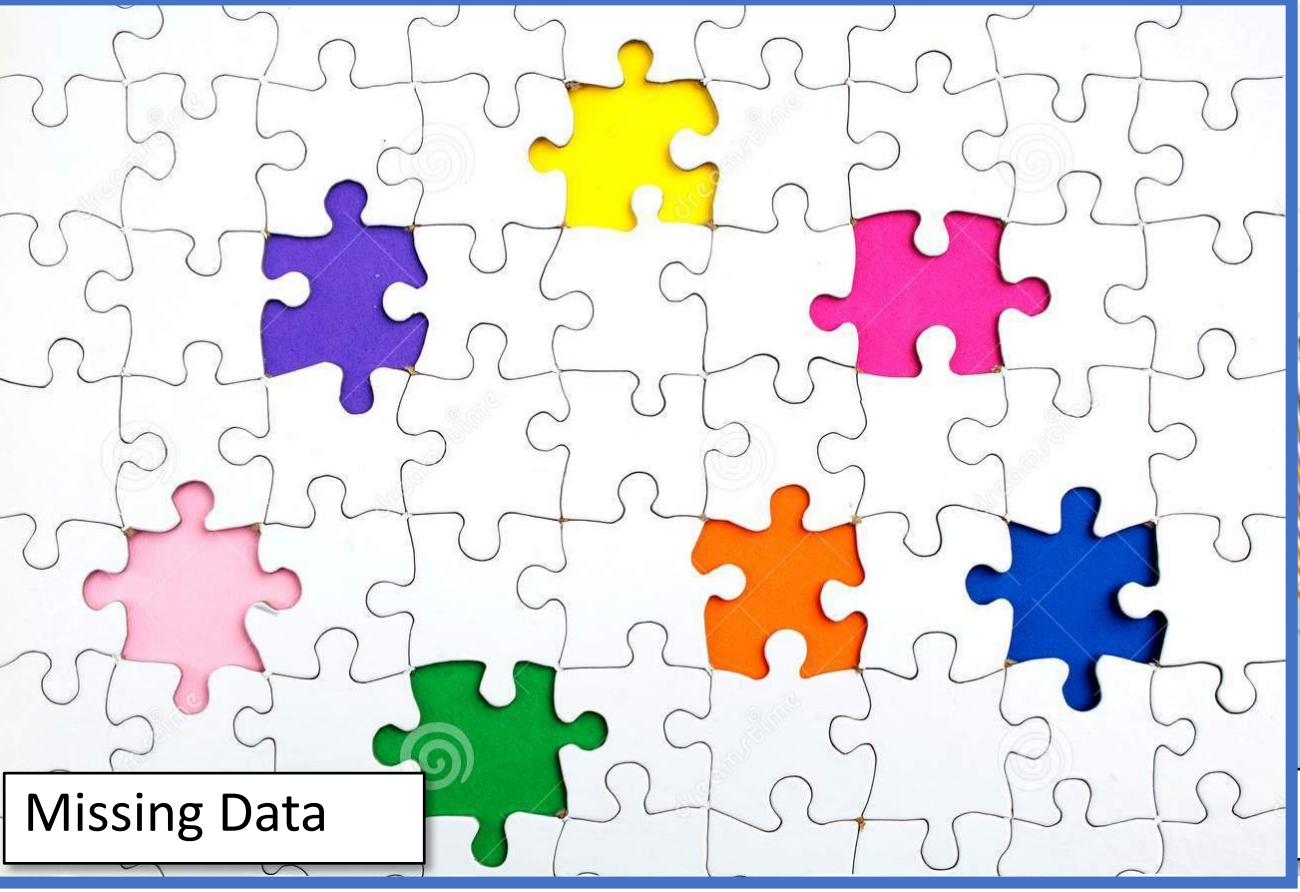
Source: CNN (2017)

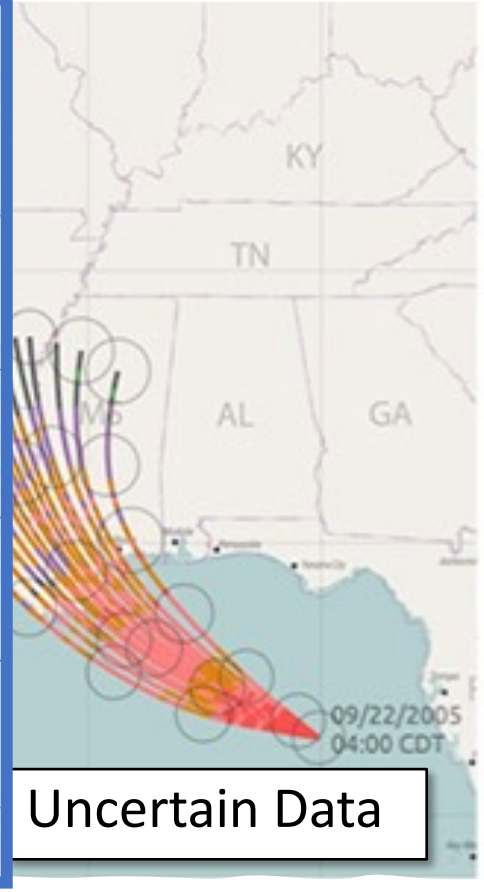
THE DIFFICULTY IN MAKING AN INFORMED DECISION: THE STORY OF FRAGMENTED DATA

Source: CNN (2017)

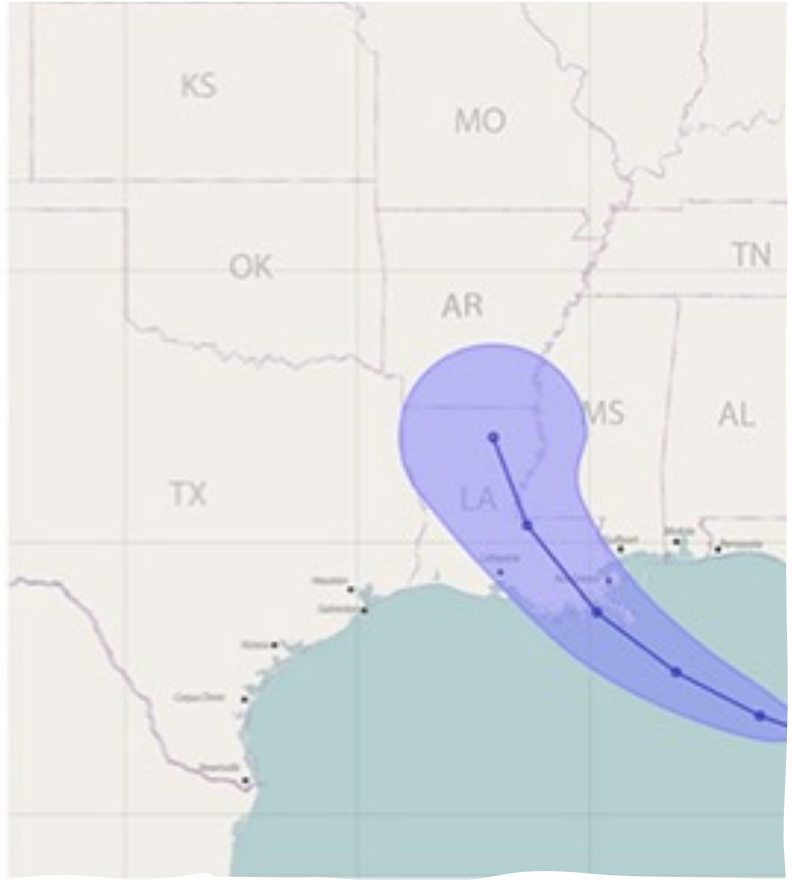
OFTEN, CURRENT DATA FAIL TO TELL THE WHOLE STORY



Missing Data



Uncertain Data



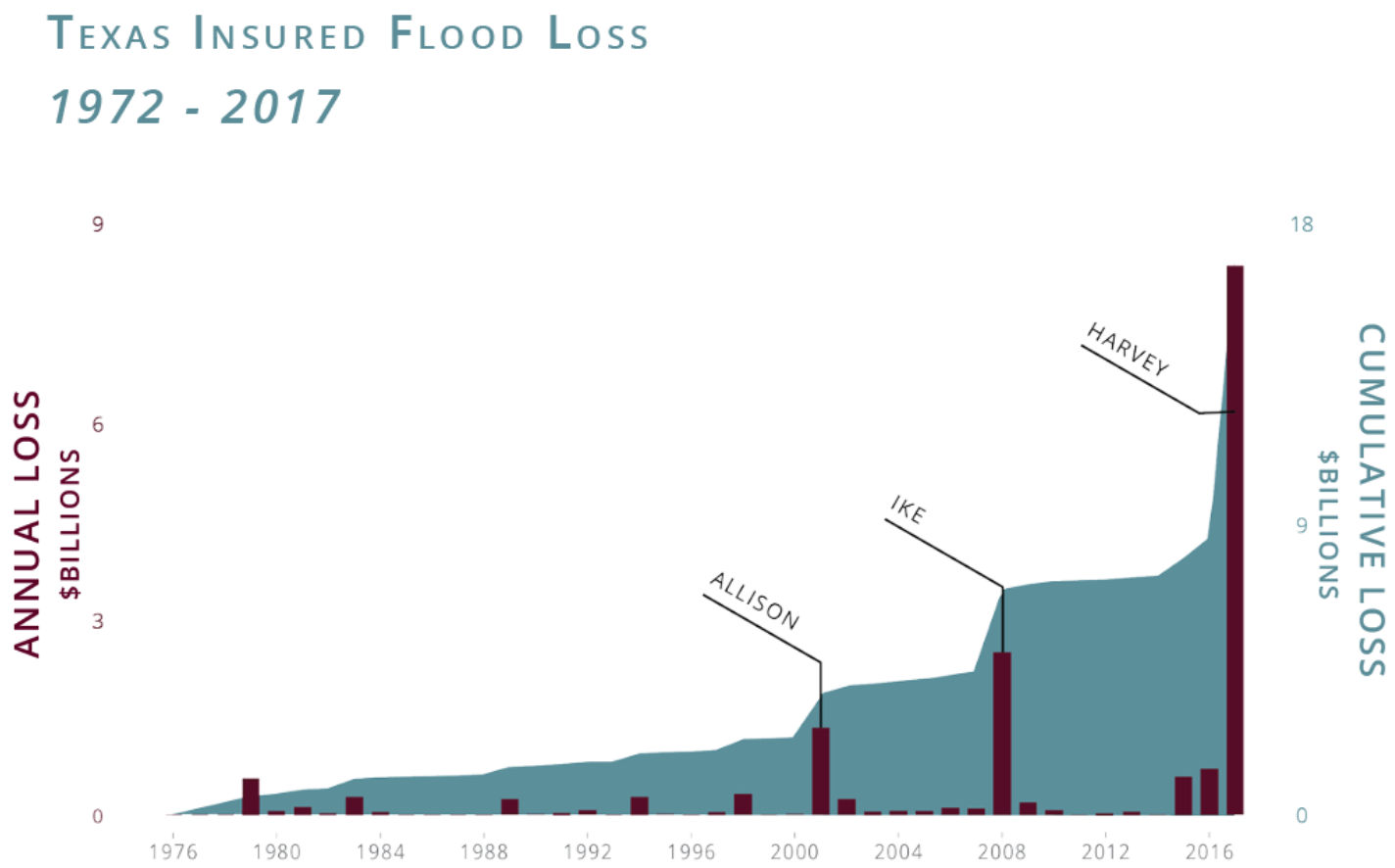
Data Issues

Background: Flooding Use Case

The U.S. flood problem is getting worse

Intense flooding is:

1. Increasing in frequency
2. Increasing in cost
3. Poorly understood



Source: FEMA National Flood Insurance Program (NFIP) Claims, Texas A&M University (2019)

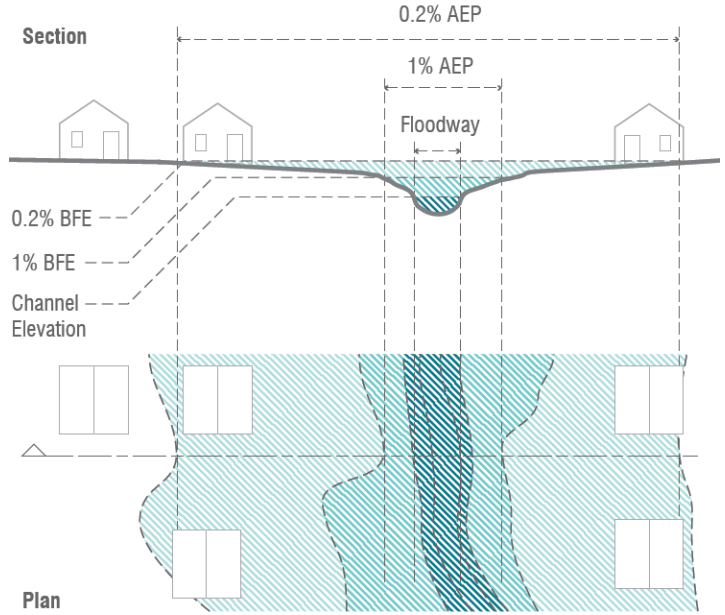
Why was the floodplain created?

Three Objectives:

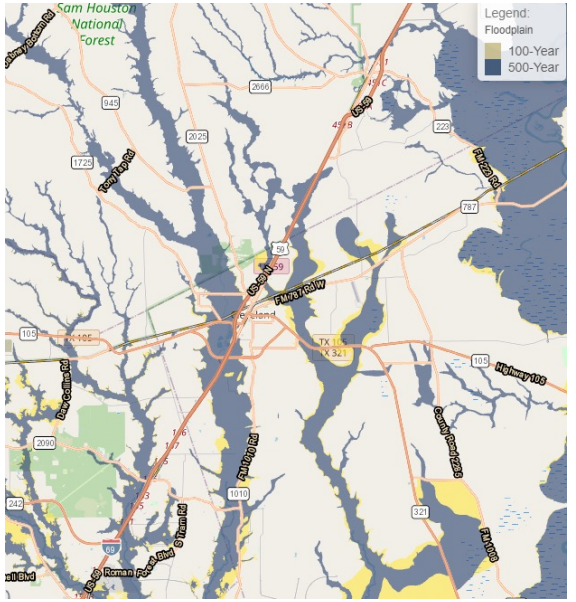
1. Set insurance rates
2. Create standards for new development
3. Discourage floodplain development

Why was it chosen?:

1. Efficient administration and implementation
2. A way to compare risks across communities



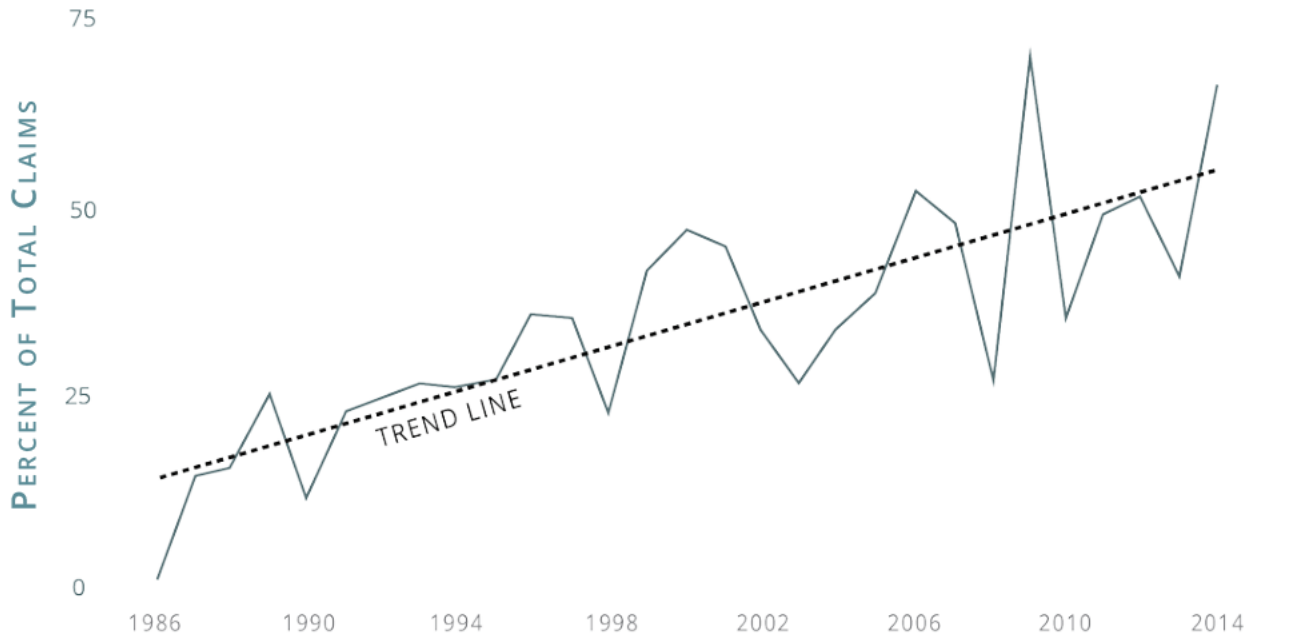
Source: Greater Houston Flood Mitigation Consortium (2019)



Floodplain fails to represent risk

1. Floodplain is Universally misunderstood by those who must cope with flood hazards.
2. The 100-year floodplain has become our de facto tool to communicate risk.
3. The dichotomous floodplain boundary results in a false sense of security.

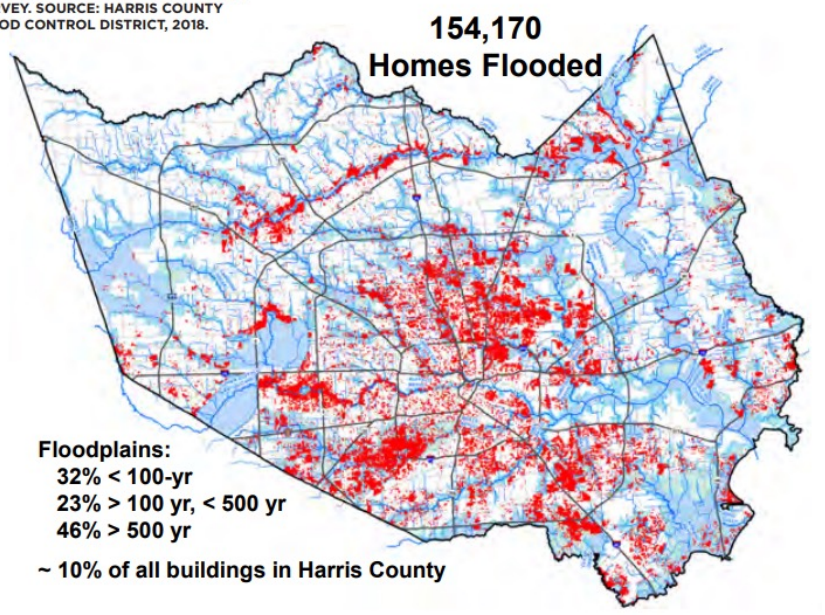
"A risk communication is successful to the extent that it contributes to the outcomes its sponsor desires."[1]

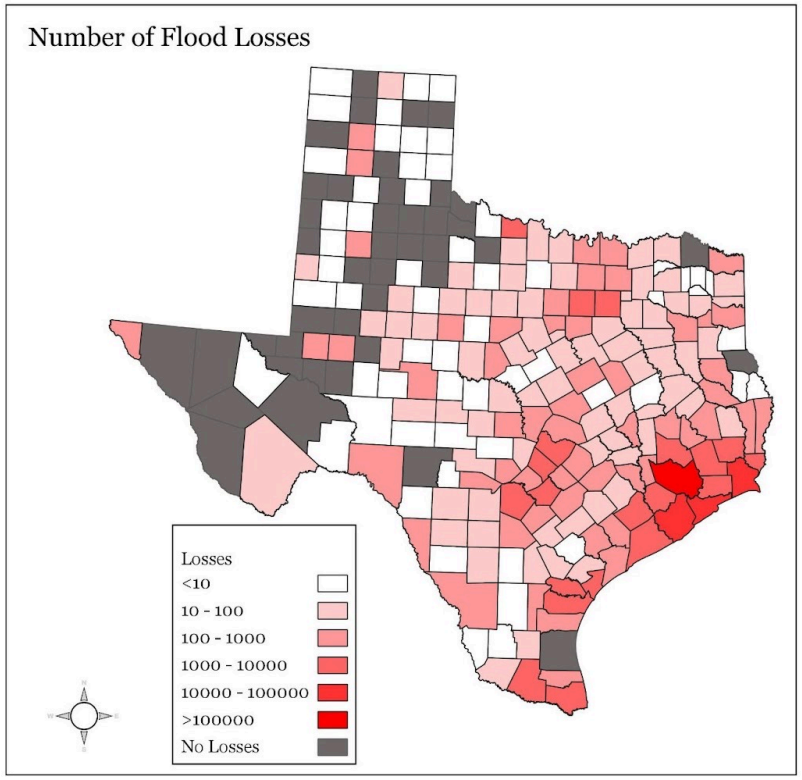


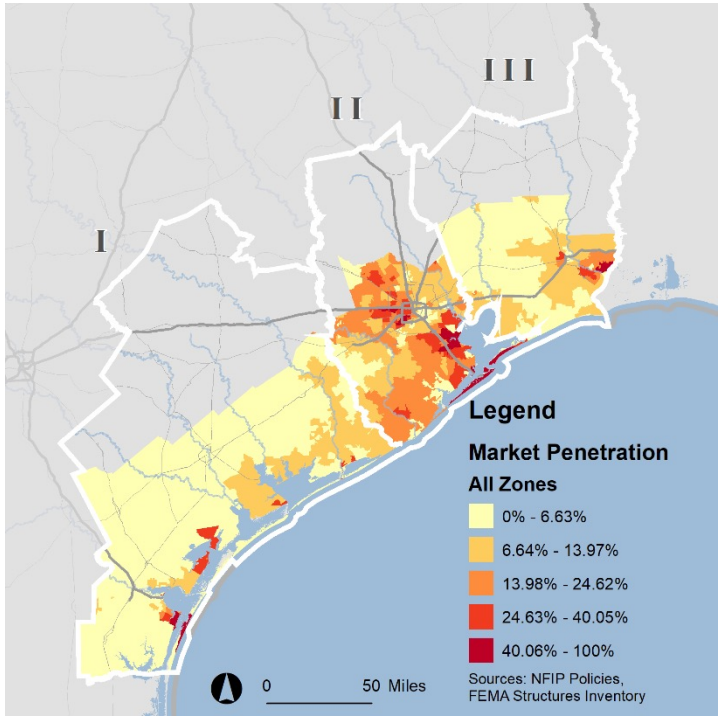
Sources: University of Maryland, and Texas A&M University, Galveston. 2019. Eye of the Storm: Report of the Governor's Commission to Rebuild Texas. 2018.

1. National Resource Council. 1989. *Improving Risk Communication.* Washington, D.C.: National Academies Press

FIGURE 17. HOMES FLOODED IN HOUSTON, TEXAS DURING HURRICANE HARVEY. SOURCE: HARRIS COUNTY FLOOD CONTROL DISTRICT, 2018.







THE GROWING THREAT OF URBAN FLOODING:

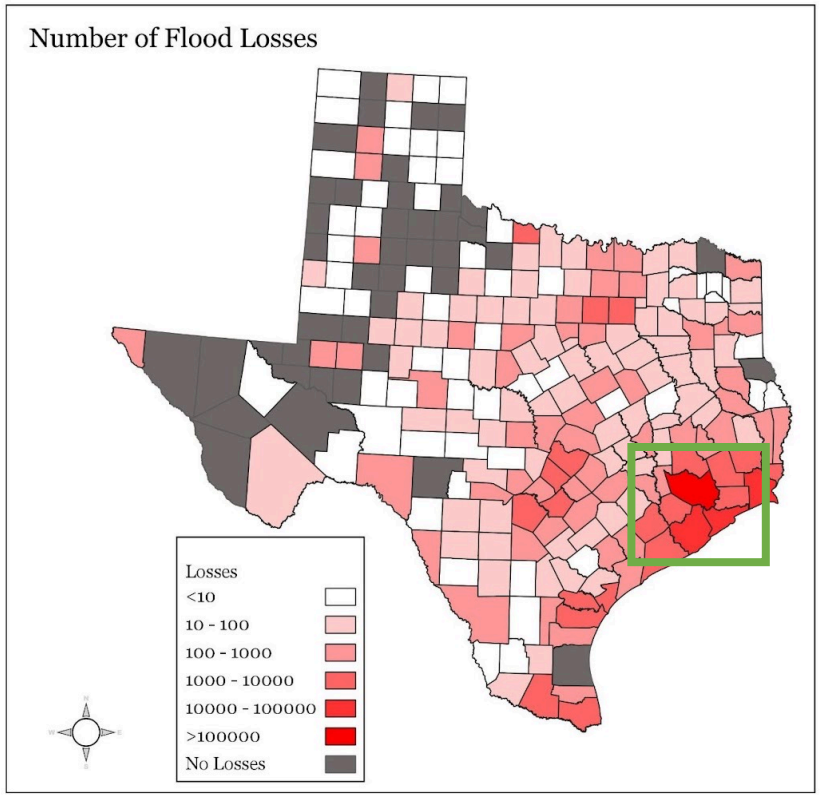
- Identifying flooding outside of the Flood Zone
- Trying to identify problems without the whole picture.
- Insurance Penetration <22%

Study area: Southeast Texas Coast (Houston)

6.6 million people

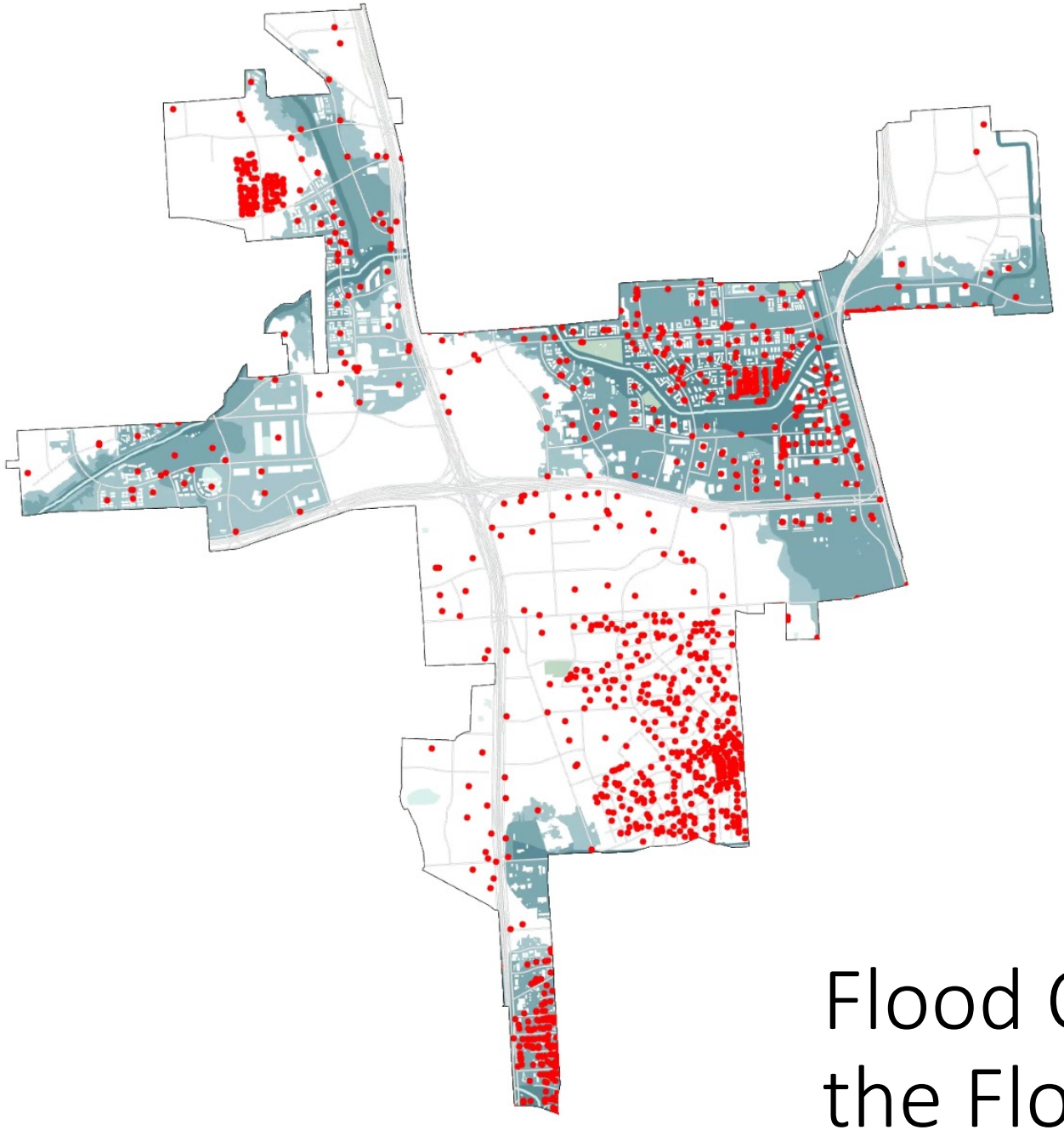
3 destructive hurricanes in 13 years.

- Ike (2008)
- Harvey (2017)
- Imelda (2019)



Filling in the data gaps: Developing the Damage Plain

The Damage Plain is a contiguous map that represents the probability of a structure at a location experiencing a damaging flood.



- Flood Claims
- Floodway
- 100-year
- 500-year

Flood Claims and the Flood Plain

Dependent Variable

Flood Exposure
Insured Flood Loss

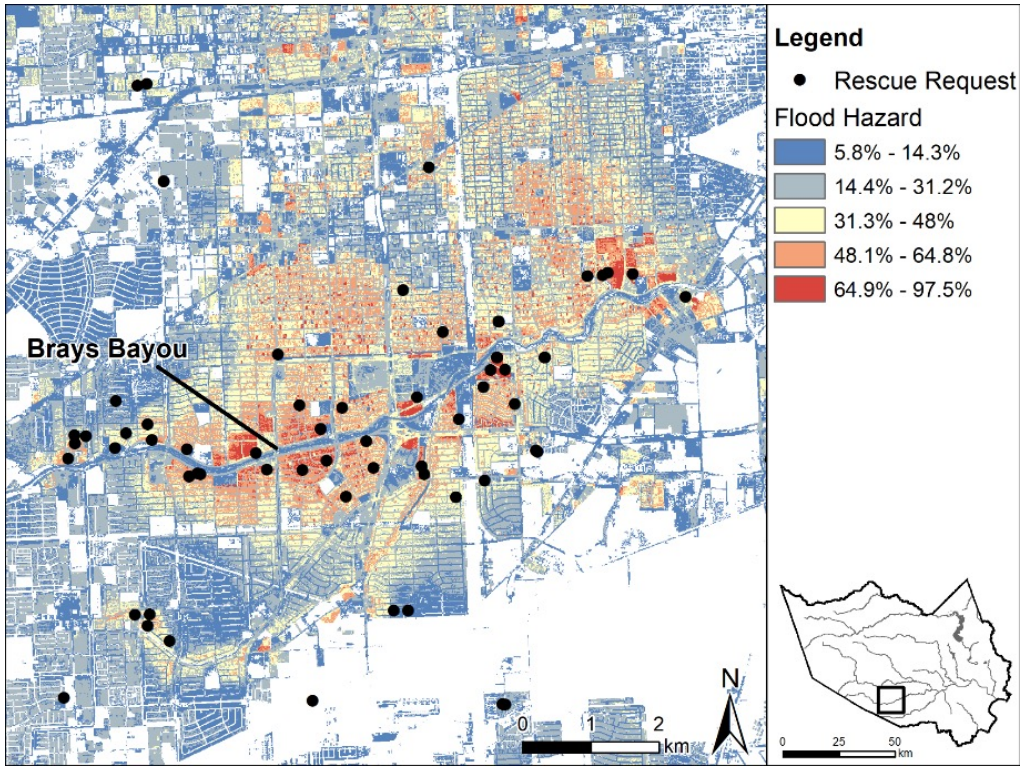
Independent Variables

Topographic
Elevation
Coast Proximity
Stream Proximity
Height Above Neareast Drainage

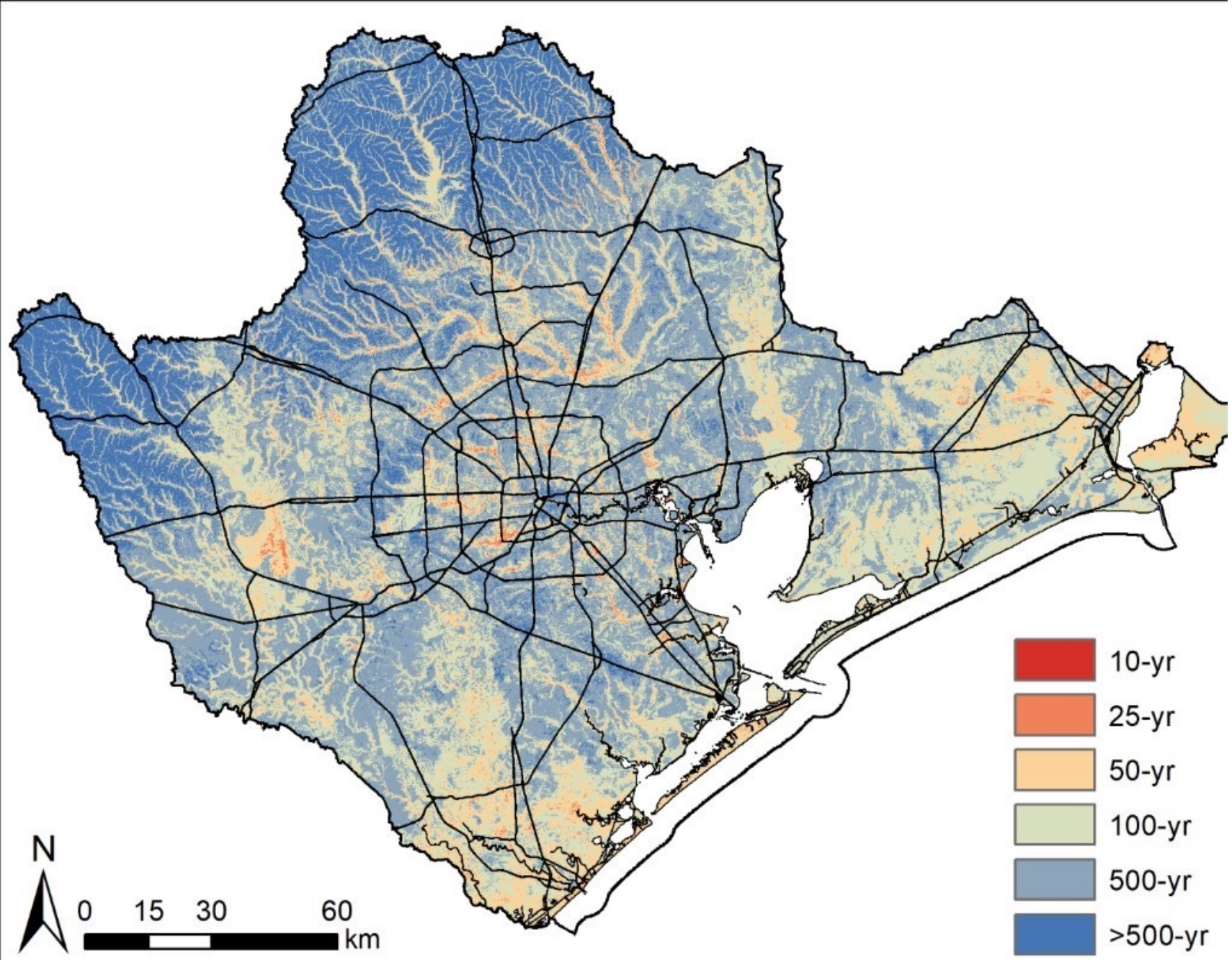
Hydrologic
Roughness
Imperviousness
Flow Accumulation
Topographic Wetness Index
Saturated Hydraulic Conductivity

Random Forest
10-Fold Cross Validation
Trees = 200
Max Depth = 90

Flood Hazard
Annualized Probability
Predicted Spatially



The Damage Plain Framework



Damage Plain Output

Annual Probability of a structure experiencing a damaging flood.

FEMA 100 - year

FEMA 500 - year

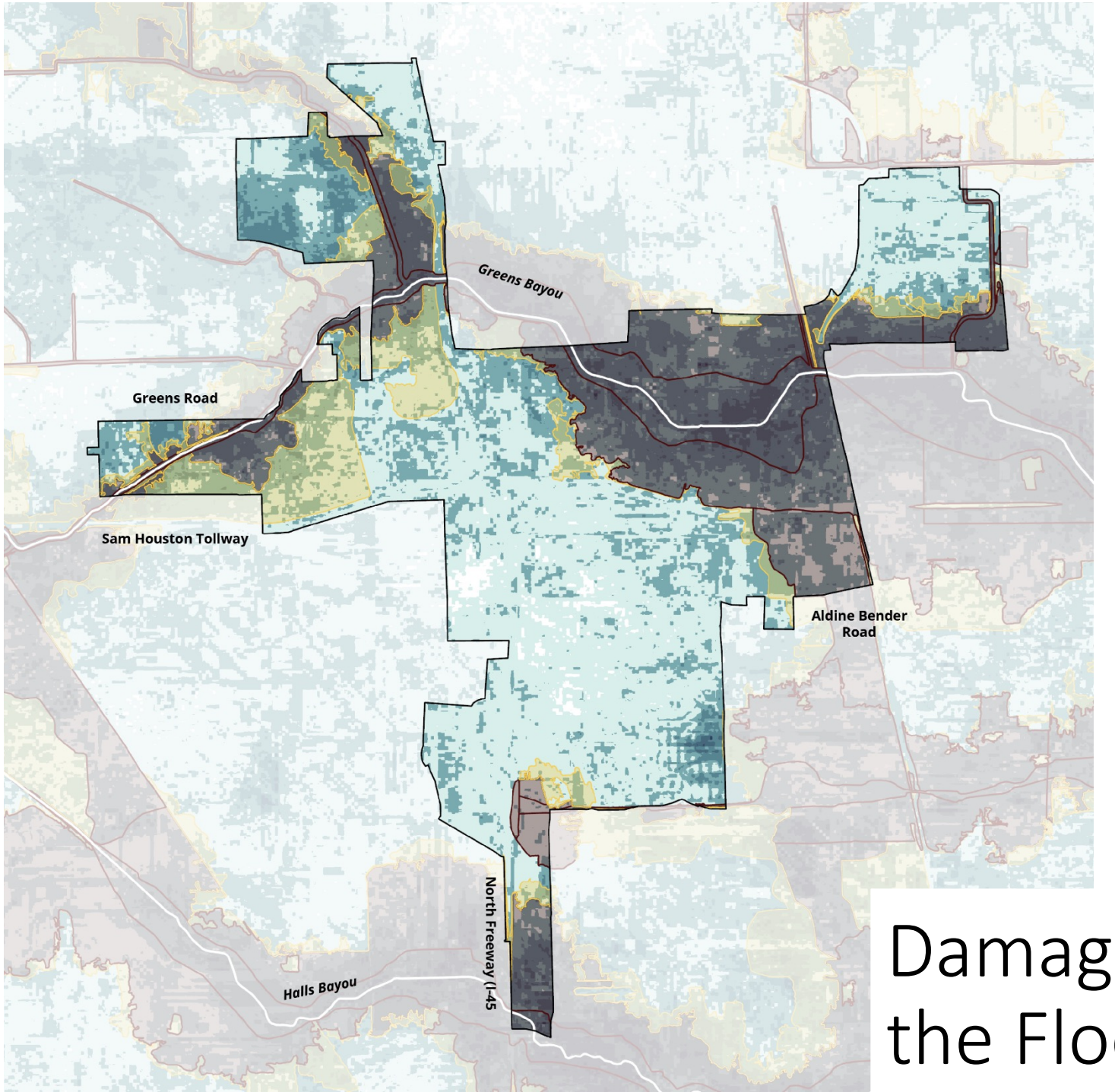
10 - year

25 - year

50 - year

100 - year

500 - year

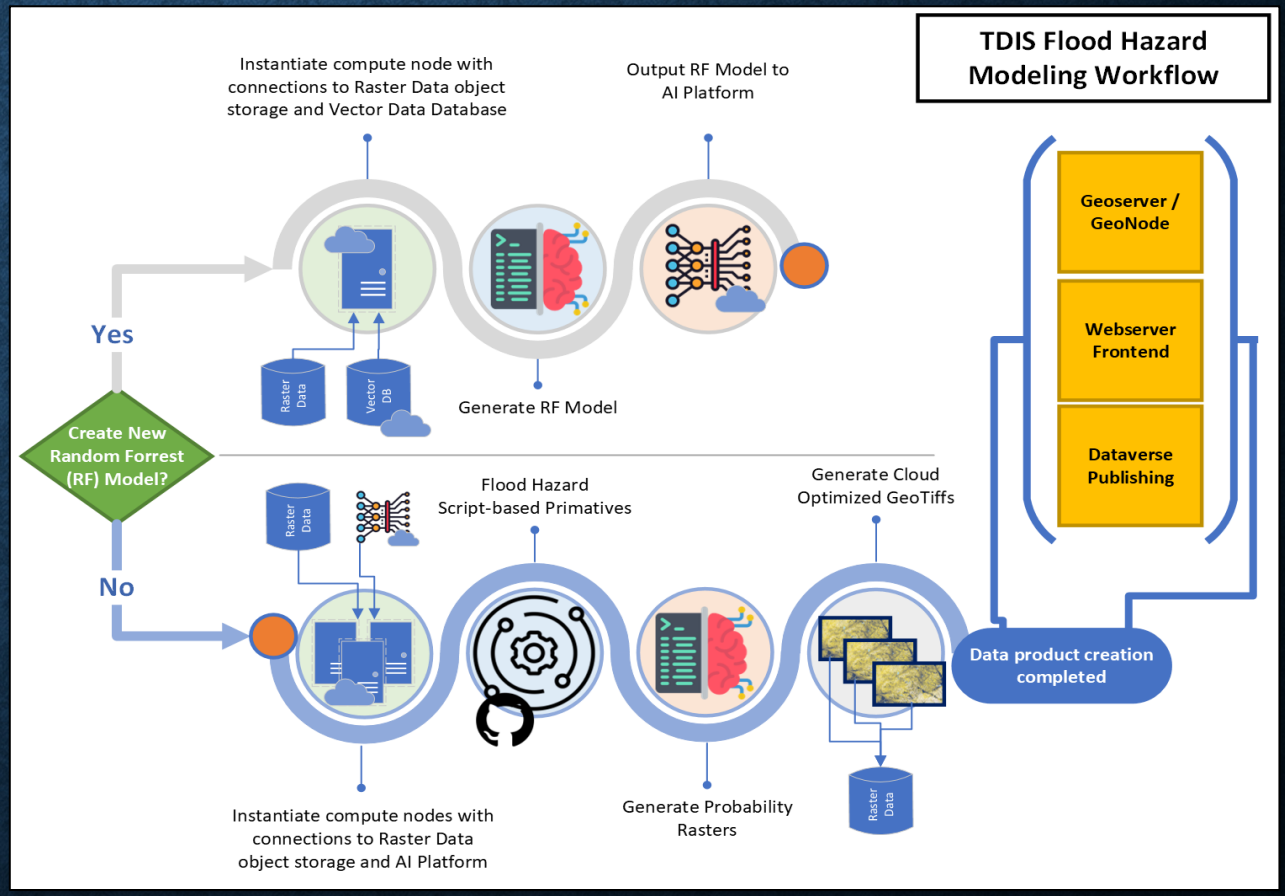


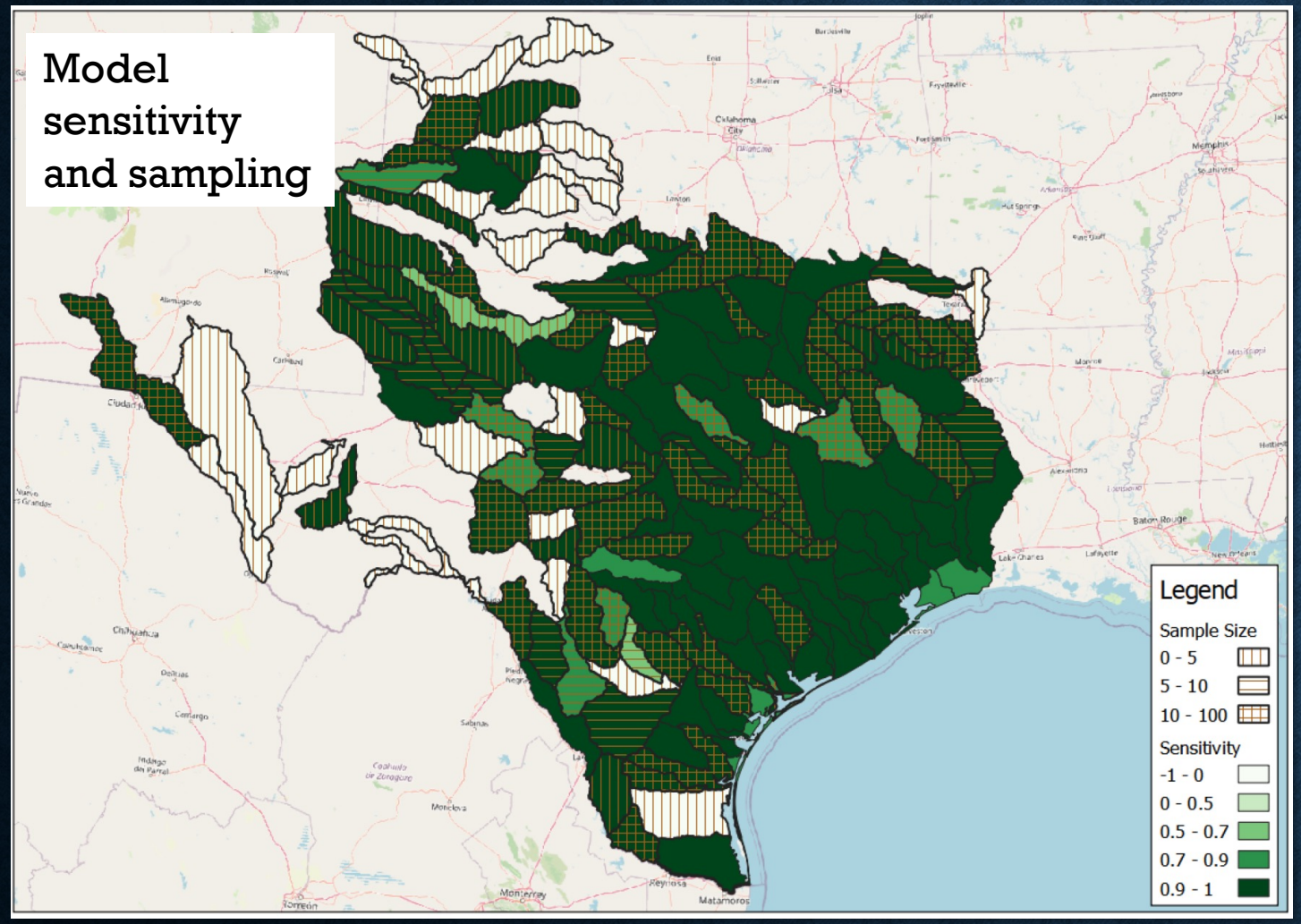
Damage Plain and the Flood Plain

Filling in the data gaps: Scaling the Damage Plain

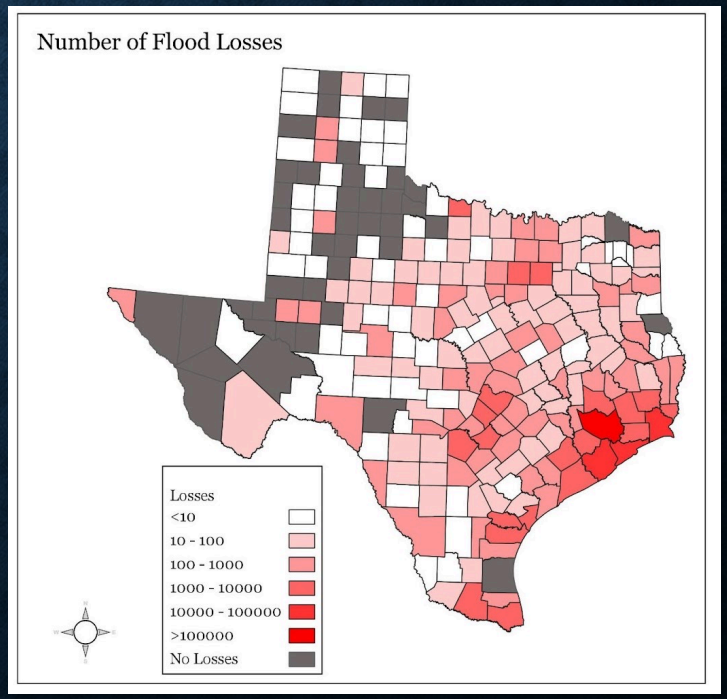
CURRENT WORKFLOW

Output	Cloud Optimized Geotiff (COG)
2 Processes	Training the Model Making the Images
Vector Storage:	PostgreSQL
Object Storage	Azure File Share •Rasters •Pickled Model
Model/Image Refresh:	Quarterly

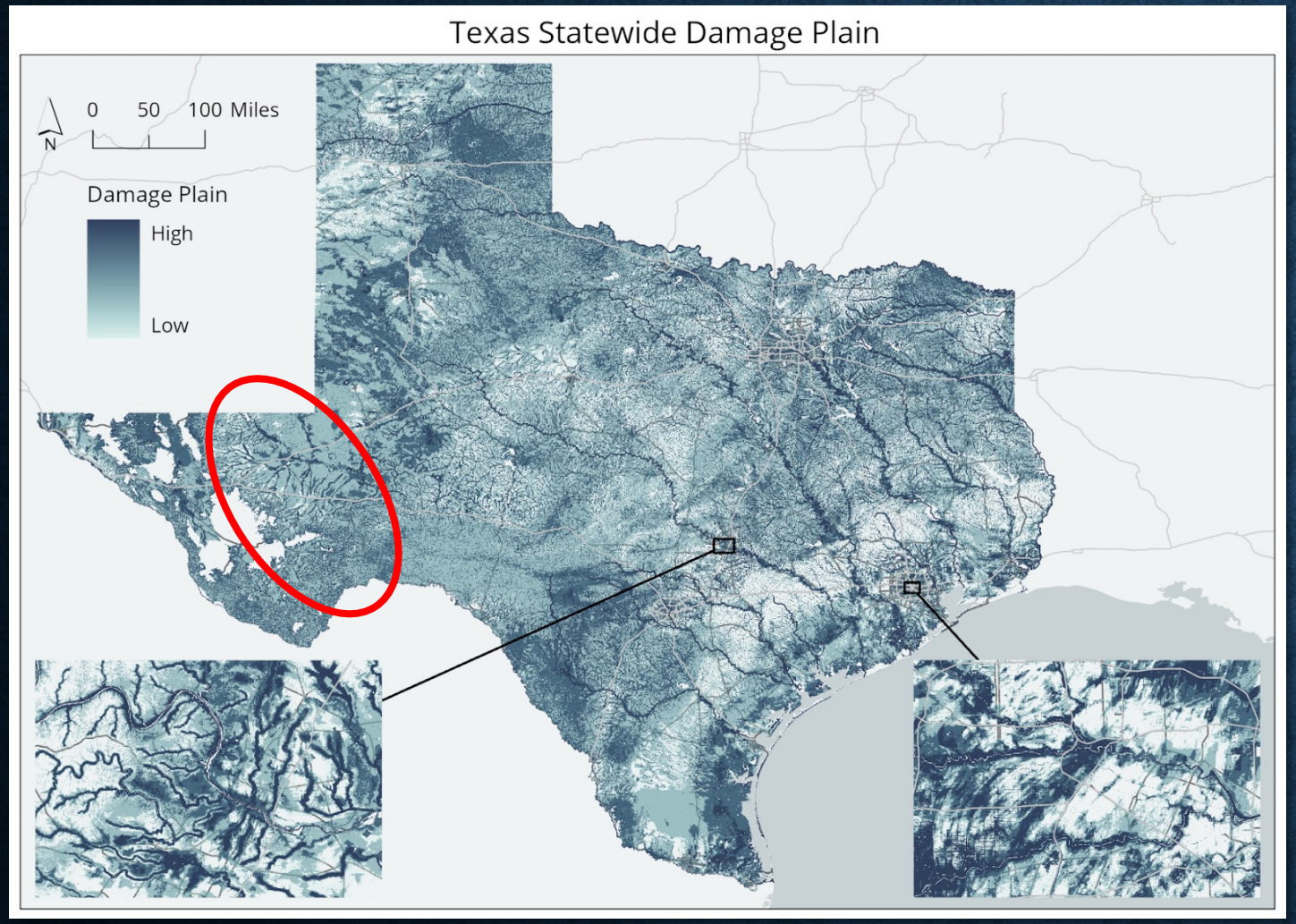




- Low Samples out West
- Lower Flood Risk but also Low Population
- Fewer NFIP Policies



QA/QC: ISSUES OF MISSING DATA



- Low Samples out West
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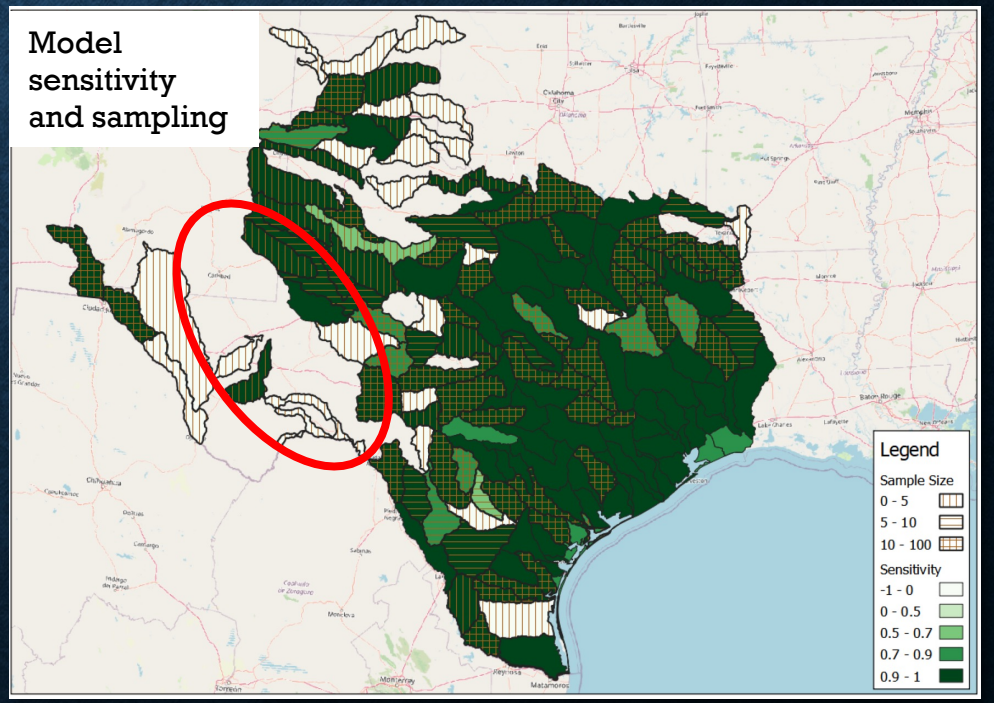
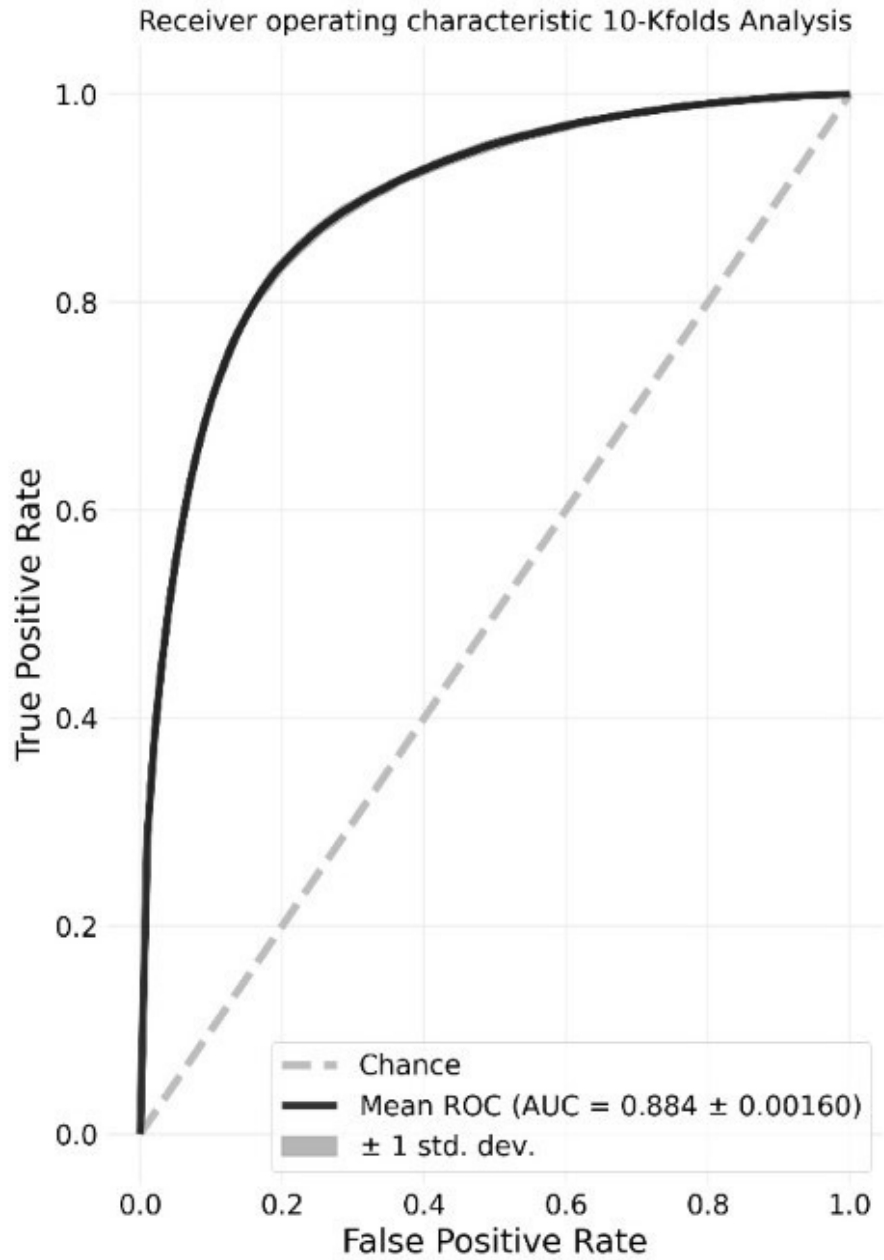
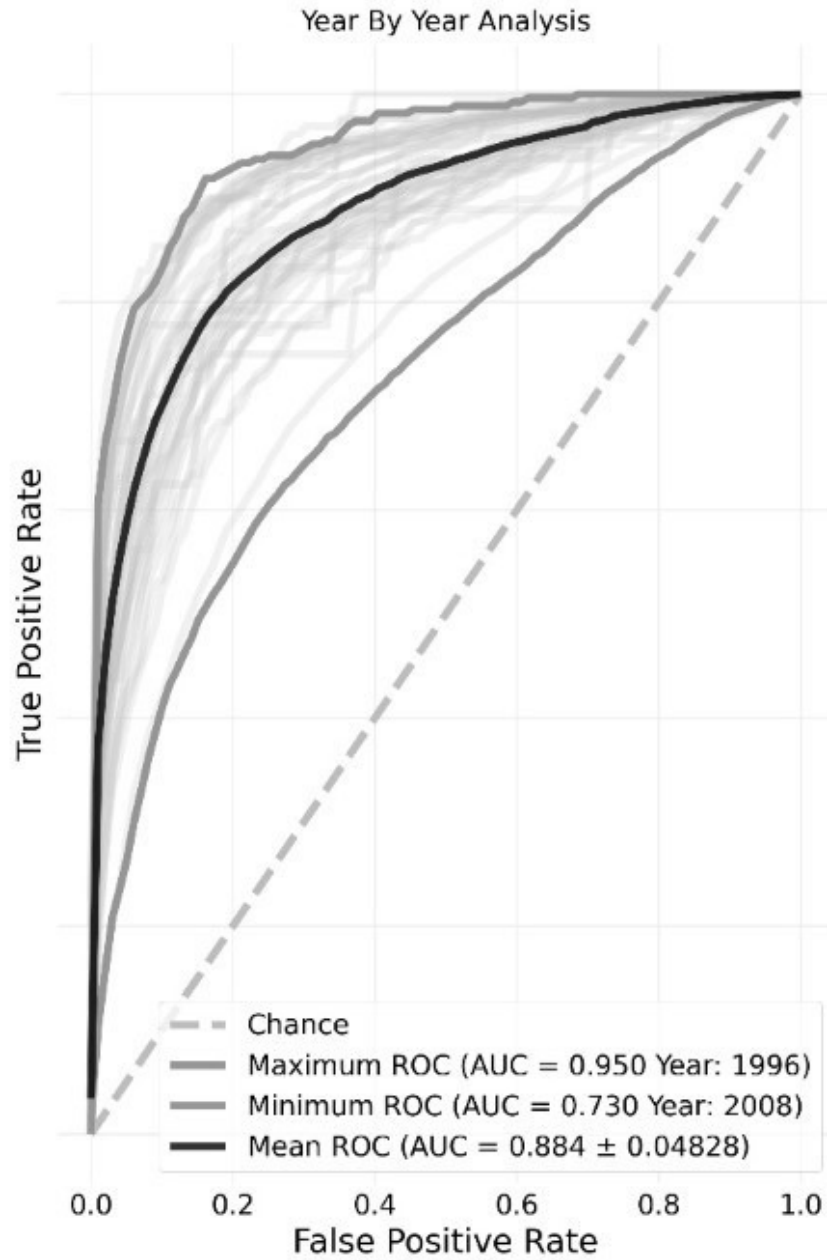
- Fewer NFIP Policies



QA/QC: REFINING OUR UNDERSTANDING OF UNCERTAIN INFORMATION

Questions?


Receiver operating characteristic 10-Kfolds Analysis
True Positive Rate
False Positive Rate
0.0
0.2
0.4
0.6
0.8
1.0
Chance
Mean ROC (AUC = 0.884 ± 0.00160)
± 1 std. dev.


Year By Year Analysis
True Positive Rate
False Positive Rate
0.0
0.2
0.4
0.6
0.8
1.0
Chance
Maximum ROC (AUC = 0.950 Year: 1996)
Minimum ROC (AUC = 0.730 Year: 2008)
Mean ROC (AUC = 0.884 ± 0.04828)