State of the Coast 2025, New Orleans, LA

A Compound Flooding Analysis of Inland-Coastal Storm Interaction in South Texas

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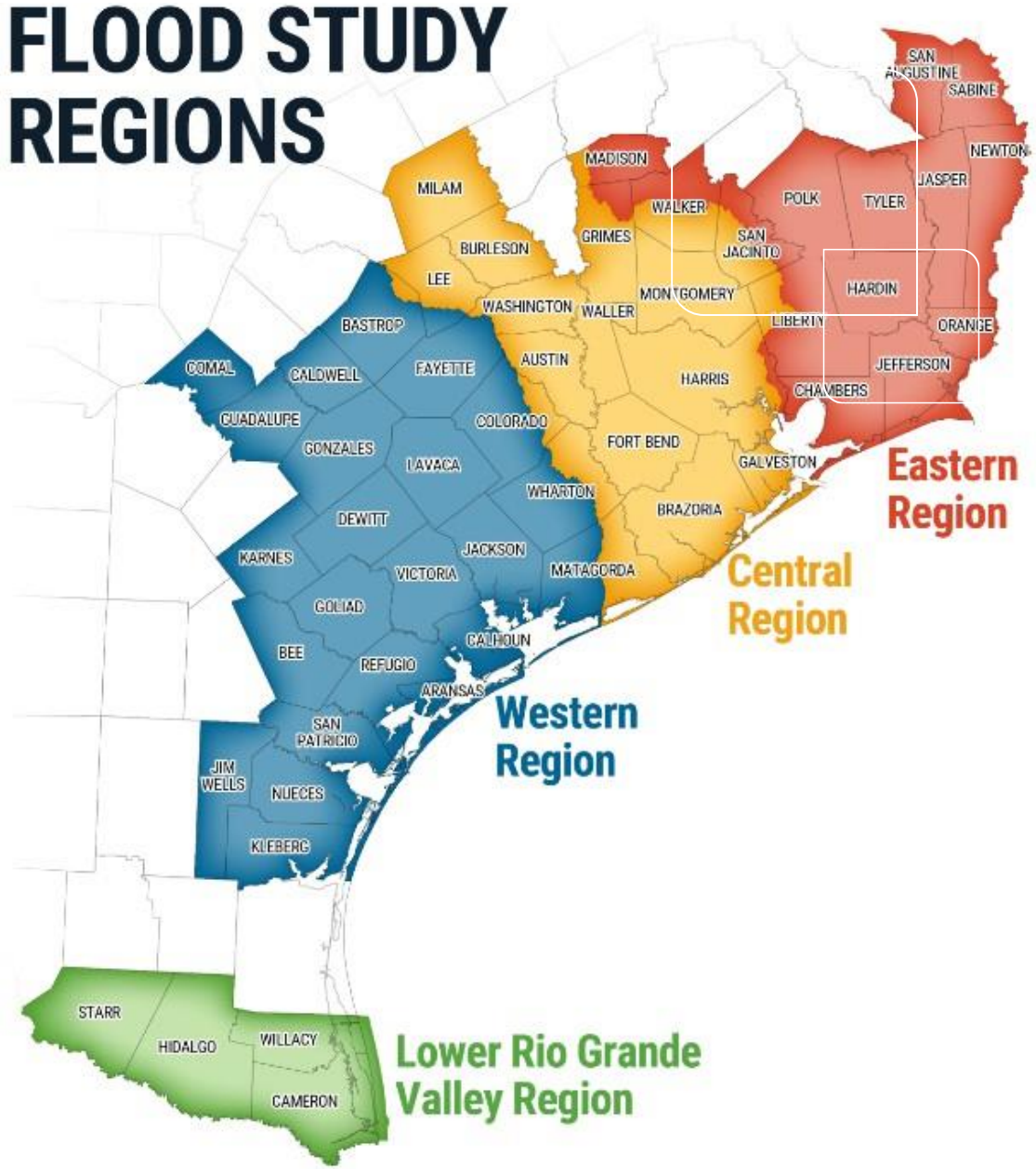
Texas GLO River Basin Flood Studies (RBFS)

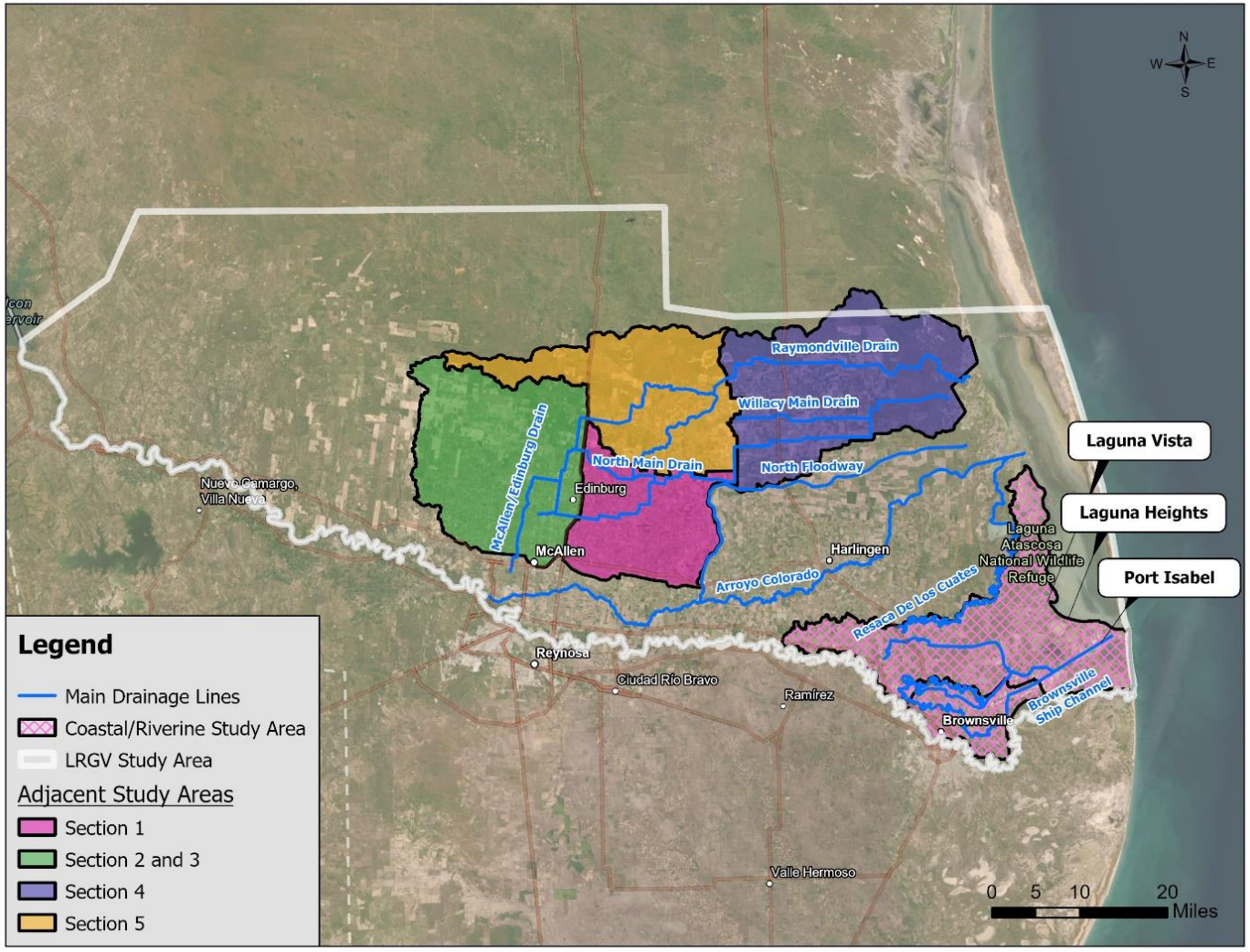
Lower Rio Grande Valley (LRGV)

- Accurately quantify and evaluate flood risks within the study area
- Assist communities in developing cost-effective flood mitigation strategies
- Determine potential funding sources for mitigation projects



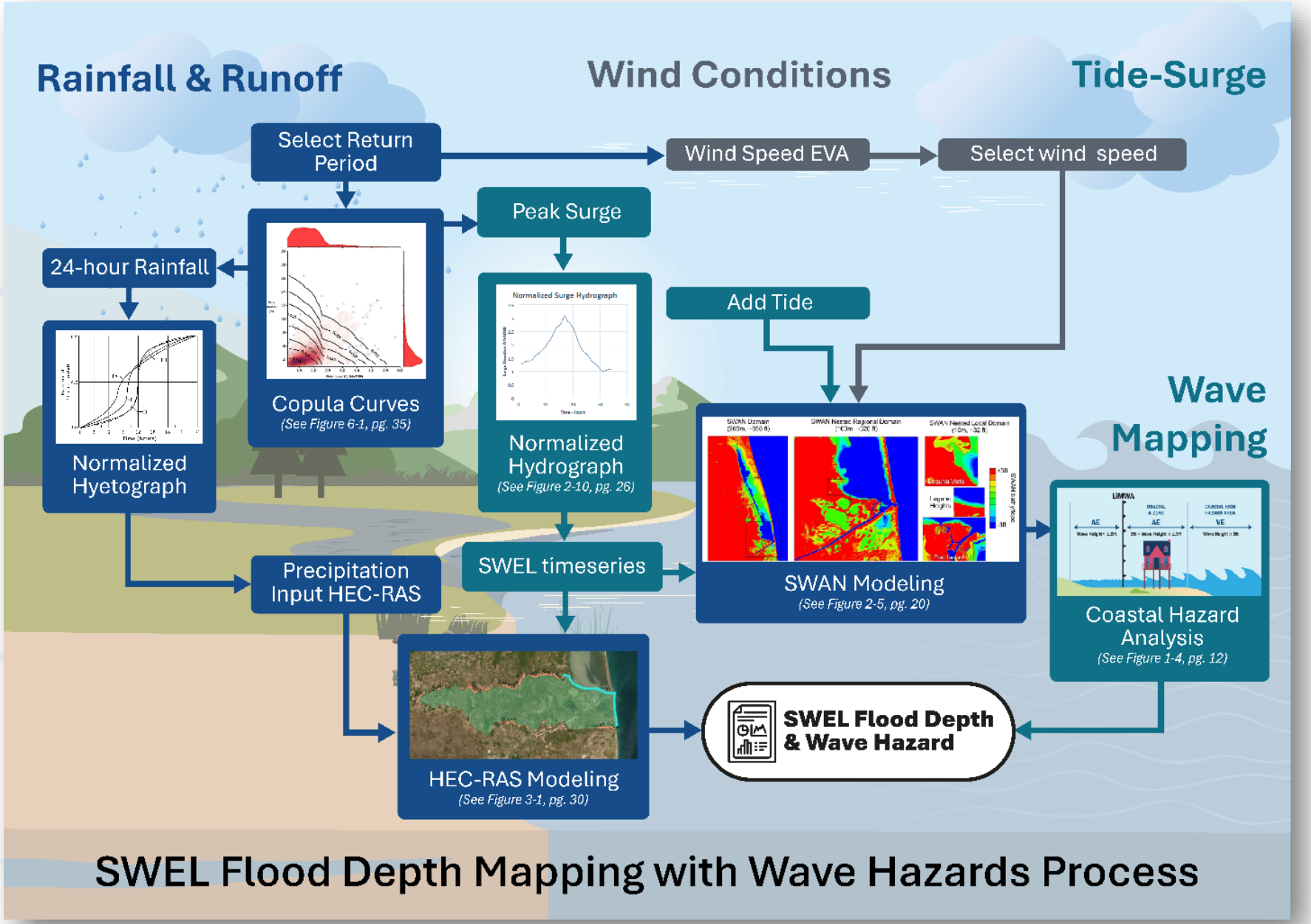
Texas GLO RBFS: LRGV

- Cameron County, TX
- Low topographic relief
- Altered drainage
- Lower Laguna Madre
- South Padre Island
- Coastal communities
  - Port Isabel
  - Laguna Heights
  - Laguna Vista



FEMA Risk Indices - Cameron County

Compound Flood Analysis Overview



Challenges in Modeling Compound Flooding

Complex Interdependencies

- Surge, rainfall, and river discharge are not independent; they interact dynamically.

Data Limitations

- Historical data on compound events is sparse, making it hard to predict future risks.

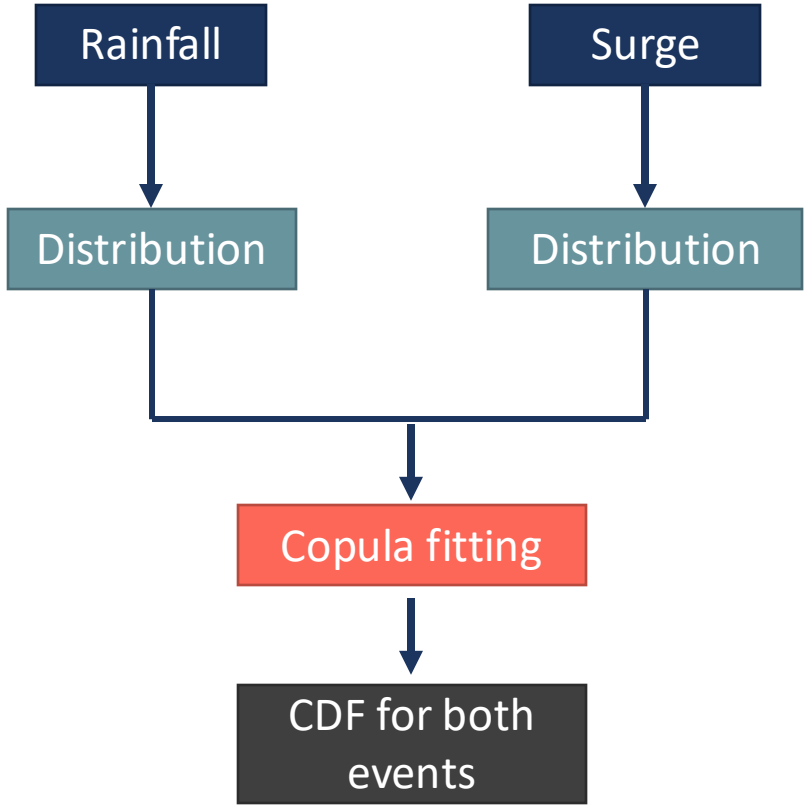
Nonlinear Relationships

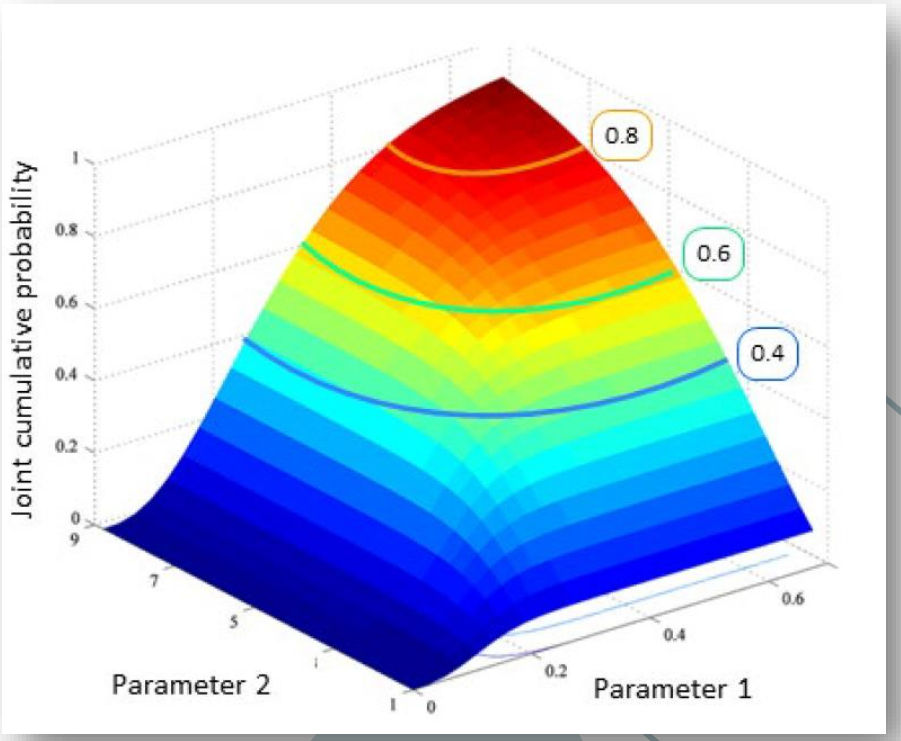
- The combined impact of surge and rainfall is often greater than the sum of their individual effects.

The Copula Process

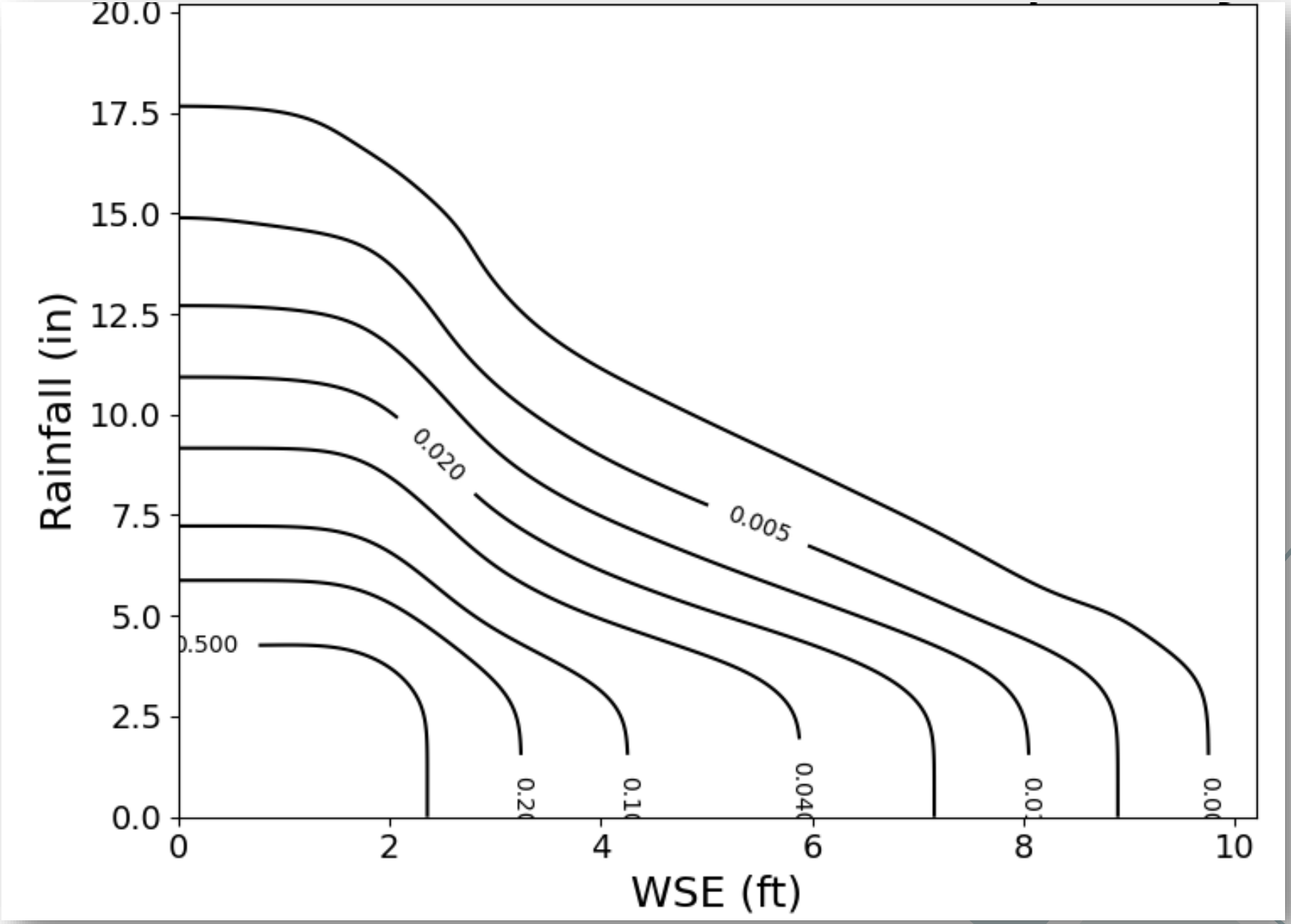
Copulas

A statistical concept used to describe the relationship between the distributions of two or more variables. It's a function that links or "couples" these marginal distributions to form their joint distribution.



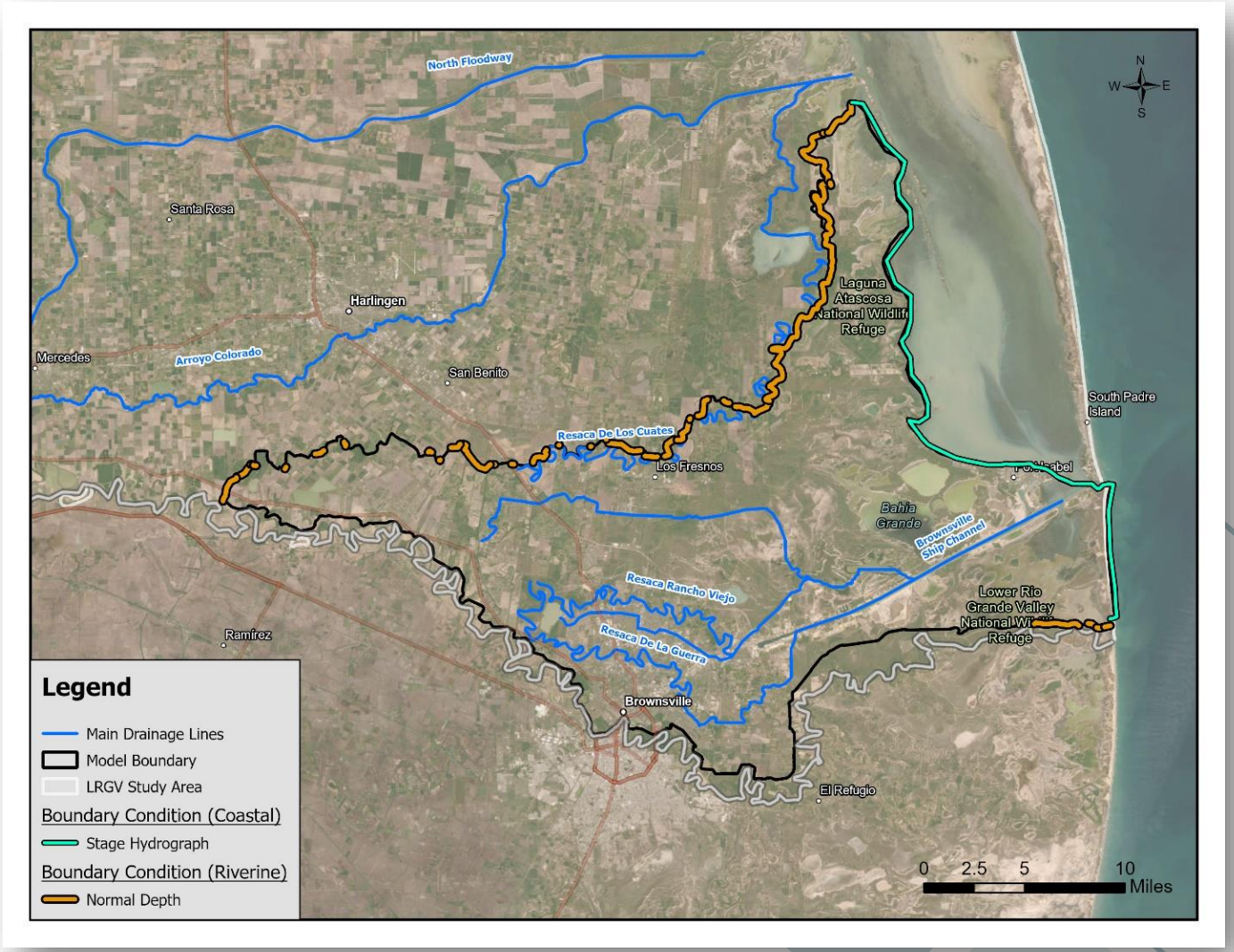


LRGV Copula


Rainfall (in)
WSE (ft)
20.0
17.5
15.0
12.5
10.0
7.5
5.0
2.5
0.0
0
2
4
6
8
10
0.020
0.005
0.500

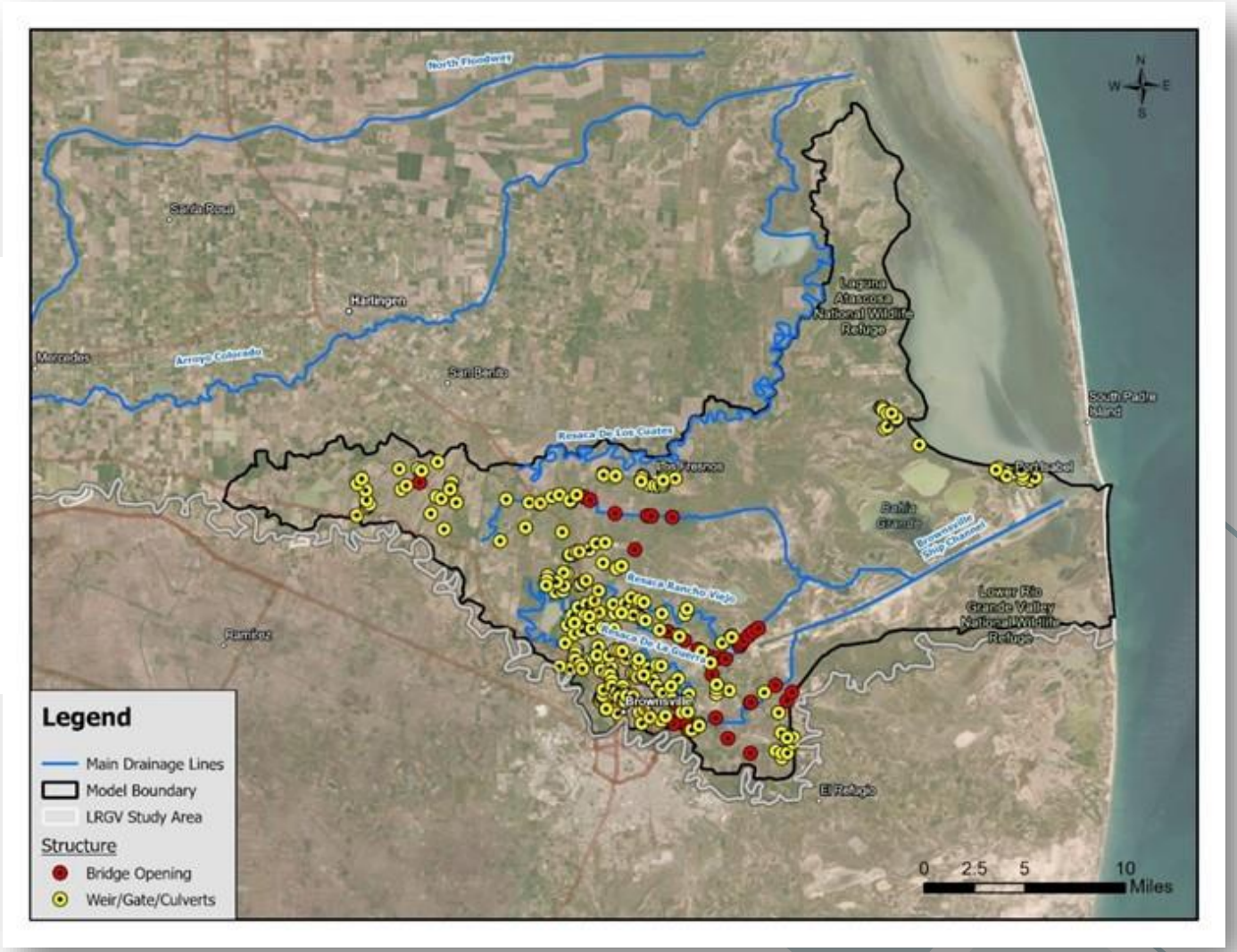
Rain-On-Mesh Modeling - HEC-RAS

- HEC-RAS 6.5
- Shallow Water Equations
- Structures
- Calibration - USGS
- AEP Events - Copula

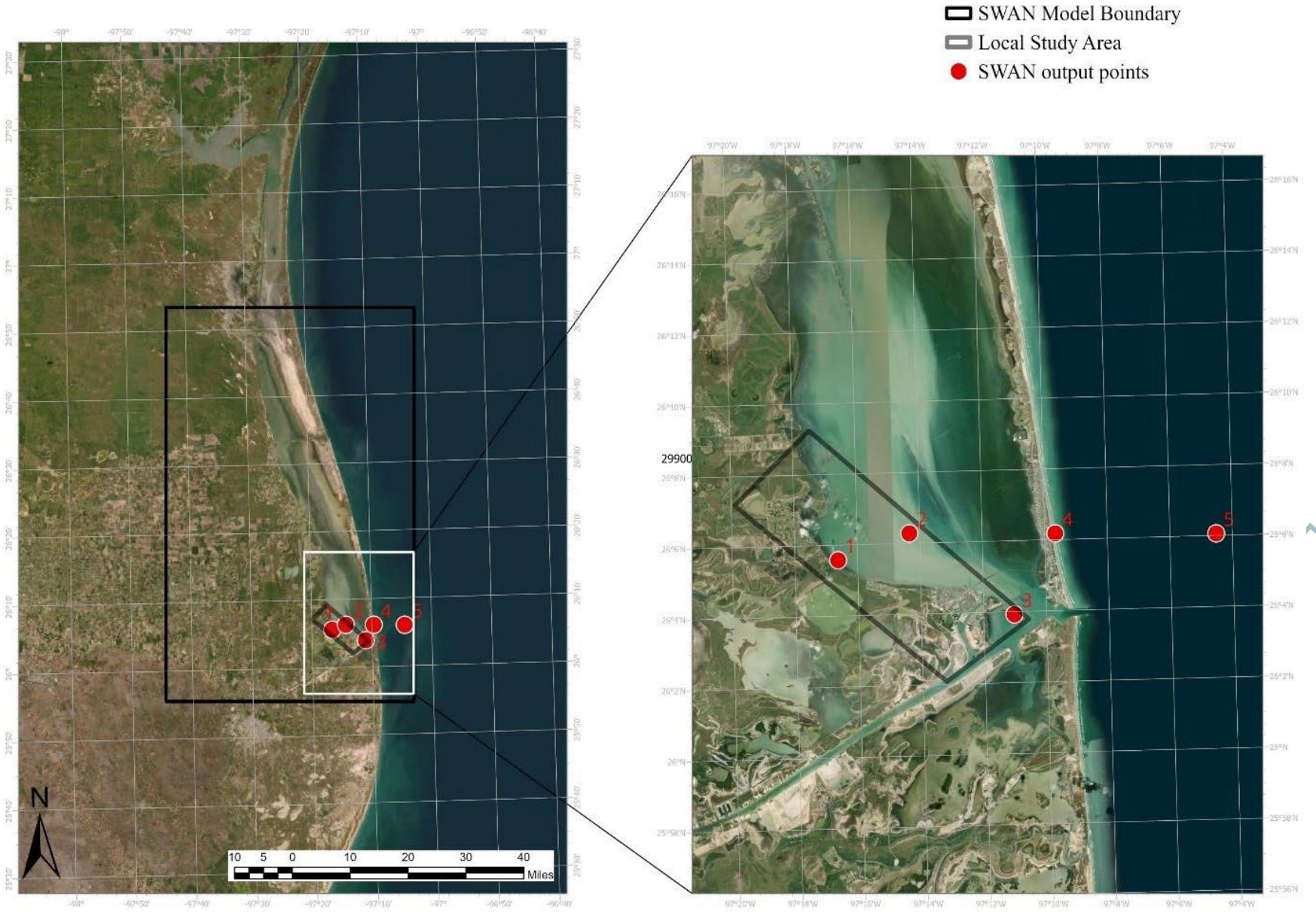


Rain-On-Mesh Modeling - HEC-RAS

USGS Gage Location	USGS Peak Stage (feet)	May 2022 Model Peak Stage (feet)	Difference (feet)
Cameron Co at FM802	9.25	9.72	0.47
Old Main Drain at SH04	5.49	4.90	-0.59
N Main Drain at Manzano St	20.67	20.91	0.24
N Main Drain at Boca Chica Hwy	22.51	22.93	0.42
Town Resaca at E 6th St	24.26	24.50	0.24

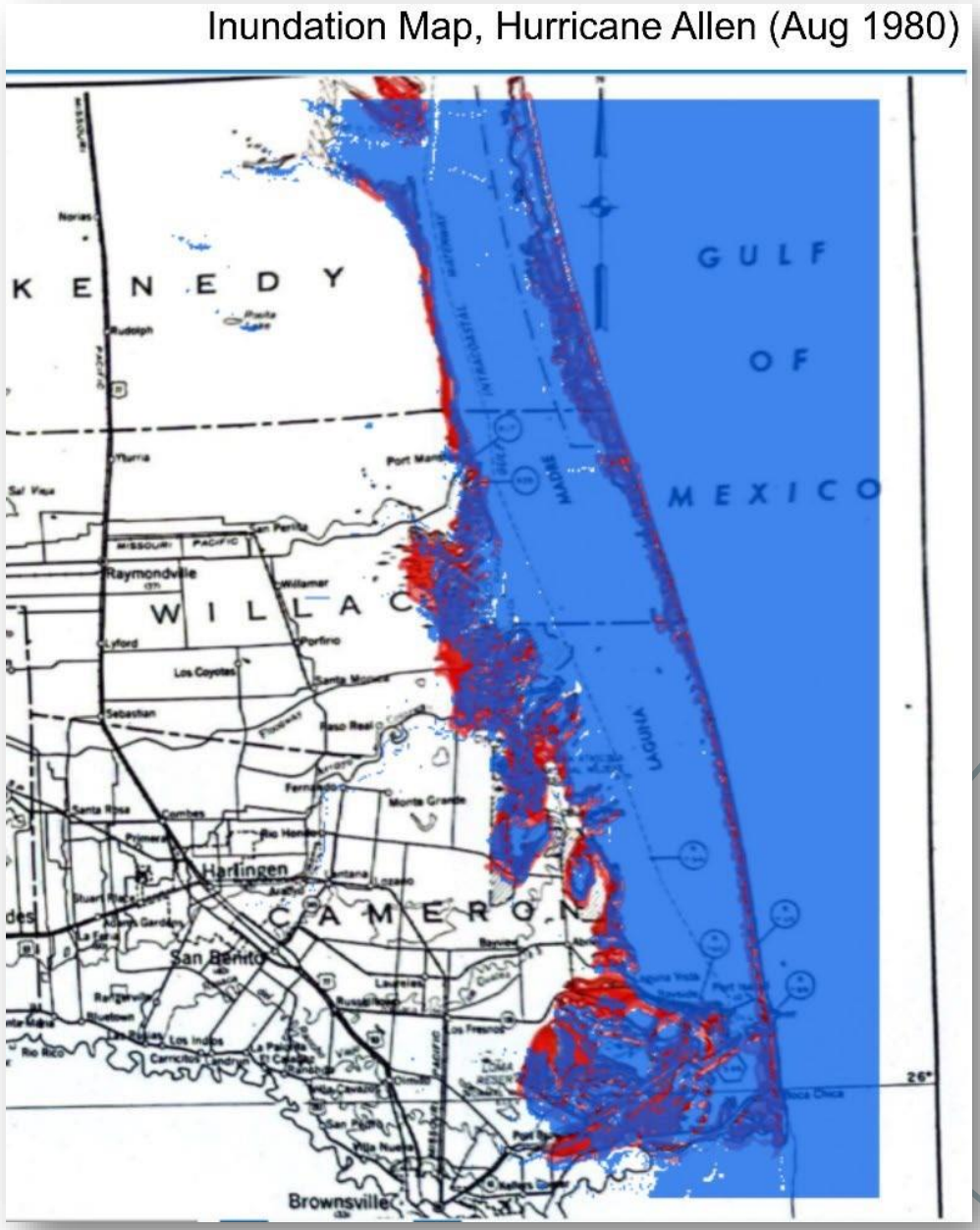


Wave Modeling - SWAN



Wave Modeling - SWAN

			Peak Nearshore Wave Height Hs (m)		
Case	Generation	Bottom Friction Method	Point 1	Point 2	Point 3
1	Janssen	Collins friction coefficient	0.88	1.46	0.84
2	Janssen	JONSWAP (friction = 0.019)	0.88	1.44	0.84
3	Janssen	JONSWAP (friction = 0.038)	0.89	1.44	0.84
4	Janssen	Madsen equiv. roughness	0.88	1.42	0.81
5	Janssen	Smith (ripple algorithm)	0.87	1.42	0.82
6	Janssen	No Bottom Friction	0.89	1.45	0.85
7	Komen	Collins friction coefficient	0.78	1.26	0.75
8	Komen	JONSWAP (friction = 0.019)	0.80	1.28	0.77
9	Komen	JONSWAP (friction = 0.038)	0.79	1.27	0.76
10	Komen	Madsen equiv. roughness	0.72	1.17	0.70
11	Komen	Smith (ripple algorithm)	0.75	1.20	0.72
12	Komen	No Bottom Friction	0.81	1.29	0.77
13	Westh	Collins friction coefficient	0.85	1.36	0.81
14	Westh	JONSWAP (friction = 0.019)	0.86	1.37	0.81
15	Westh	JONSWAP (friction = 0.038)	0.85	1.36	0.81
16	Westh	Madsen equiv. roughness	0.82	1.32	0.78
17	Westh	Smith (ripple algorithm)	0.83	1.33	0.79
18	Westh	No Bottom Friction	0.86	1.37	0.81



Results

Laguna Vista

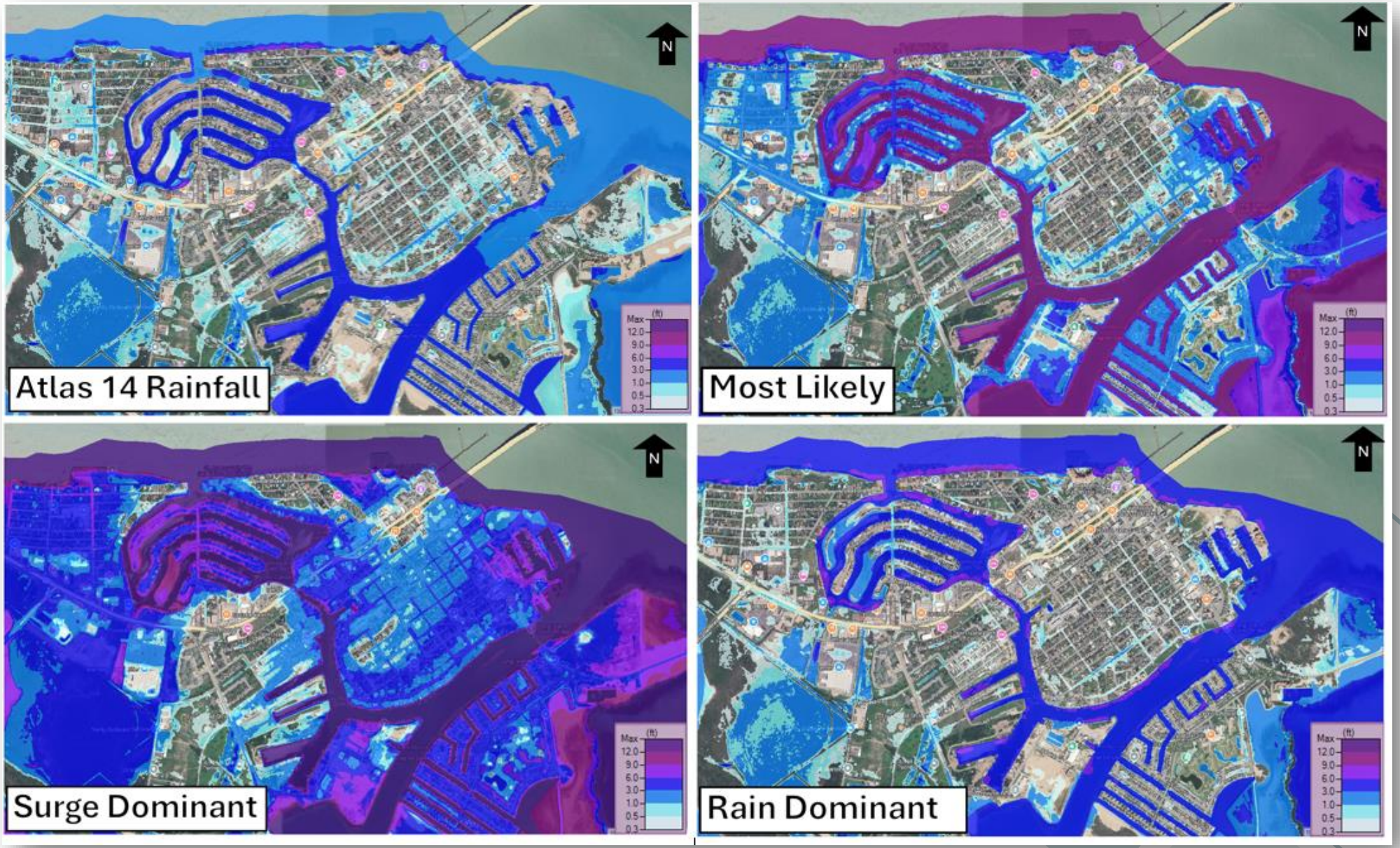
Hs (ft)
- 0 - 1 ft
- 1 - 2 ft
- 2 - 3 ft
- 3 - 4 ft
- 4 - 5 ft
- 5 - 6 ft
- 6 - 7 ft
- 7 - 8 ft
- 8+ ft

Laguna Heights

Port Isabel

N

Results


Atlas 14 Rainfall
Most Likely
Surge Dominant
Rain Dominant
N
Max
(ft)
12.0
9.0
6.0
3.0
1.0
0.5
0.3

NEXT STEPS

- Analyze results of the baseline modeling and confirm mitigation areas
- Perform alternatives analysis following Standard Operating Procedures (SOP) established by the Texas GLO RBFS
- Engage with communities
- Progress feasible alternatives and assist development of grant funding applications

Q&A

TXGLO

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