Incorporating Flood Vulnerability into Bridge Rehabilitation Planning Case Study: Miami-Dade County, FL

Nasim Mohamadiazar[1], PhD Candidate; Ali Ebrahimian[2], PhD
[1, 2] Department of Civil and Environmental Engineering, Florida International University
[1] *nmoha031@fiu.edu* [2] *alebrahi@fiu.edu*

Florida International University

Accelerated Bridge Construction University Transportation Center

Overview

American Road & Transportation Builders Association

- 1 out of 3 U.S. bridges needs to be replaced or repaired (American Road & Transportation Builders Association (ARTBA), 2023).
- There is an urgent need for effective bridge construction and renovation.

Objectives

- Developing a Risk-based, Spatial, Multi-criterion, Multi-stakeholder Decision Analysis Framework for the Prioritization of Upgrade/Repair Projects based on:
  - Structural and traffic condition of bridges
  - Flood and socio-environmental vulnerability of bridge location

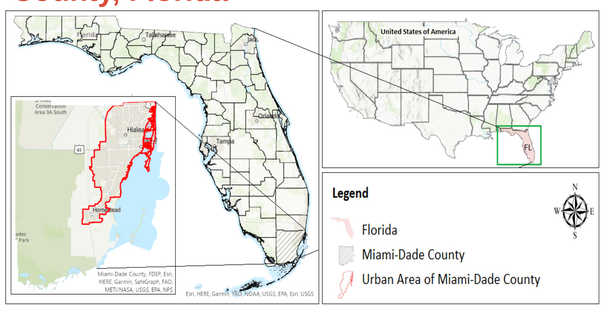
Why Flood?

- Flood can disrupt traffic flows.
- Bridges need to be operational as quickly as possible after a flood event.
- Repairs require additional resources and time to divert water flow.
- Flood can damage construction equipment during repair, further delaying projects.

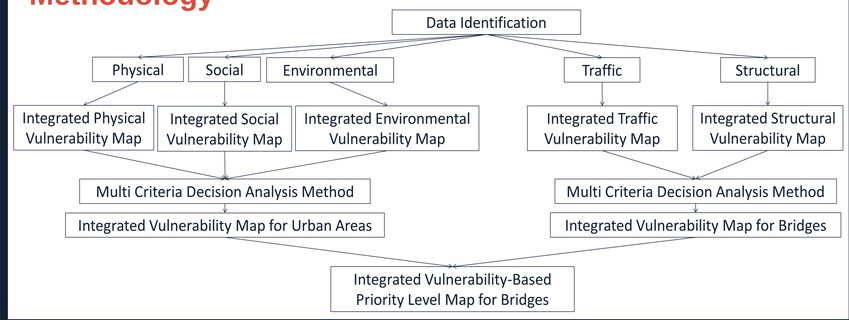
Why Socio-Environmental?

- To address the needs of underserved communities, (e.g., low-incomes).
- To ensure that these groups have equitable access to basic amenities.
- To reduce environmental hazards (e.g., air pollution) exposure that disproportionately affect vulnerable communities.

Study Area: Urban Areas of Miami-Dade County, Florida

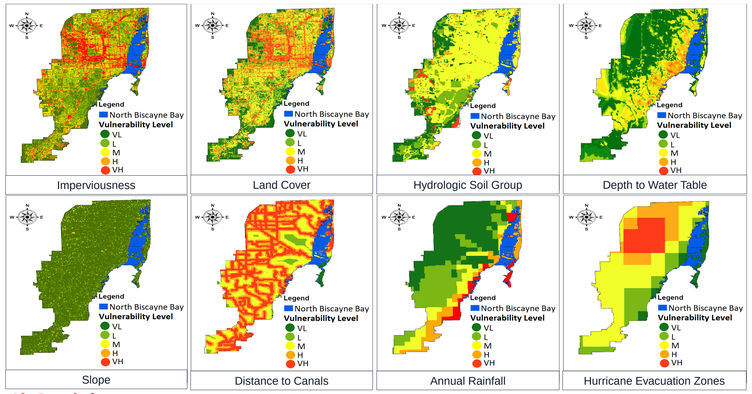


Methodology

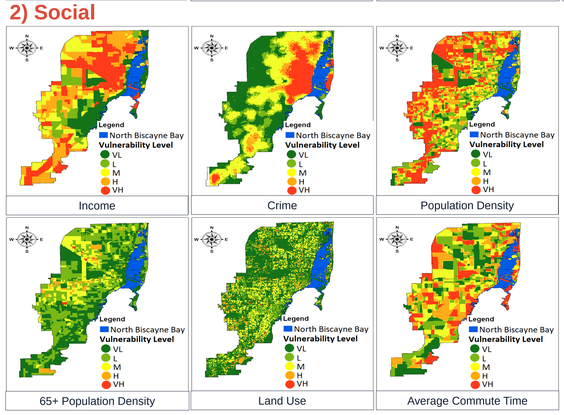


Data

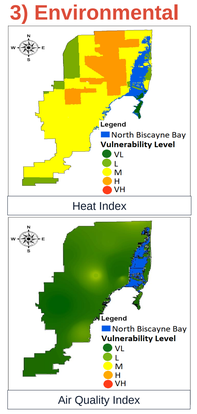
1) Physical (Flood)



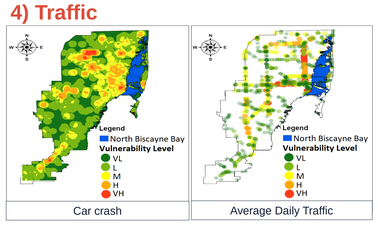
2) Social



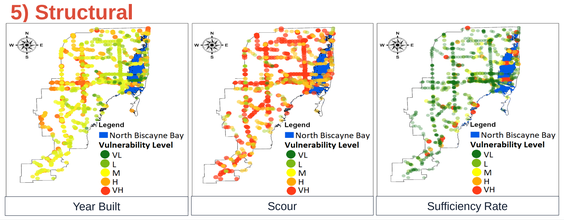
3) Environmental



4) Traffic

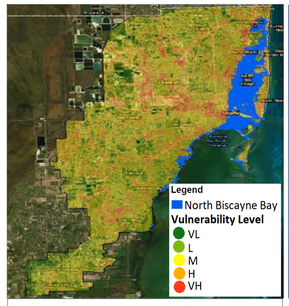


5) Structural

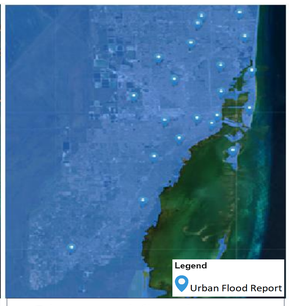


Results: Flood Vulnerability Validation

- A total of 187 historical flood points were obtained from online social media platforms, which then manually were validated by cross-referencing with the Miami-Dade county 311flood reports.
- The validation revealed an accuracy rate of 89.9%.



Flood vulnerability map

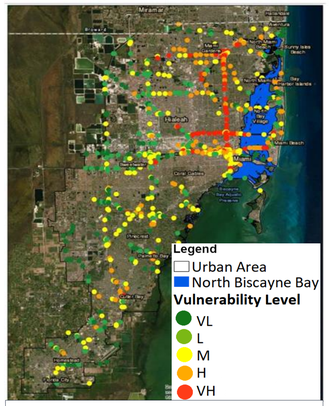


Observed flood events

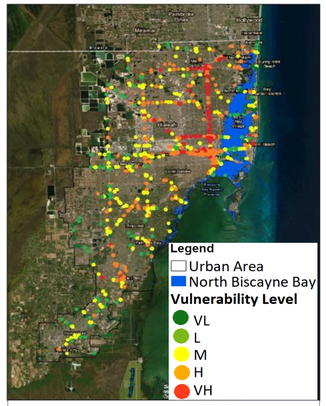
Vulnerability-based Prioritization of Bridges in Different Scenarios

Representative scenarios including various assumptions for the criteria weights

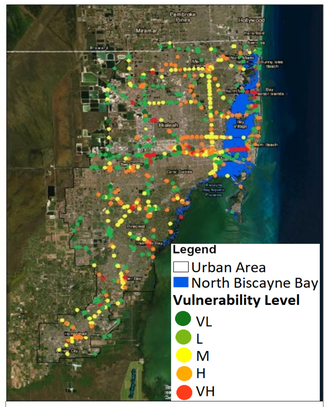
Scenarios	Traffic	Structural	Flood	Environmental Justice	Social Equity
Scenario-1	0.50	0.50	0.00	0.00	0.00
Scenario-2	0.35	o.35	0.30	0.00	0.00
Scenario-3	0.30	0.30	0.20	0.10	0.10



Scenario-1



Scenario-2



Scenario-3

Conclusion

- Considering flood vulnerability, social equity, and environmental justice in addition to traffic and structural condition of bridges can change the prioritization of construction projects.
- The developed decision support framework can practically support DOTs for equitable prioritization of bridge construction projects.
- The decision support framework is structured, flexible, and adjustable.

Acknowledgement

This work is funded by USDOT through a grant from Accelerated Bridge Construction University Transportation Center (ABC-UTC) at Florida International University.

Citation

Mohamadiazar N, Ebrahimian A, Azizinamini A. (2024). Equitable Prioritization of Bridge Rehabilitation Projects Using a Spatial Multi-Criteria Decision Support Framework. Transportation Research Record, 0(0).

SCAN ME