# Chaining Recovery Decision Support

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NIST CENTER FOR RISK-BASED COMMUNITY RESILIENCE PLANNING

Resilience

# Goals and challenges

- High dependency on infrastructure and supply chains networks
  - Normal operation: Facilitates governance, safety, wellbeing
  - Abnormal operation: Economic loss, health and security issues
- Current concerns
  - Accelerated growth (space/demand/technology) and interdependency
  - Decentralized information and decision making (modeling/operation/control)
  - Multiple scales
    - Geographical: local, regional, global
    - Temporal: days, months, years
  - Natural and anthropogenic hazards

# Seaside (tradeoffs between objectives)

- Population stability

- Economic stability

- Social Services stability

- Physical Services stability

- Governance stability
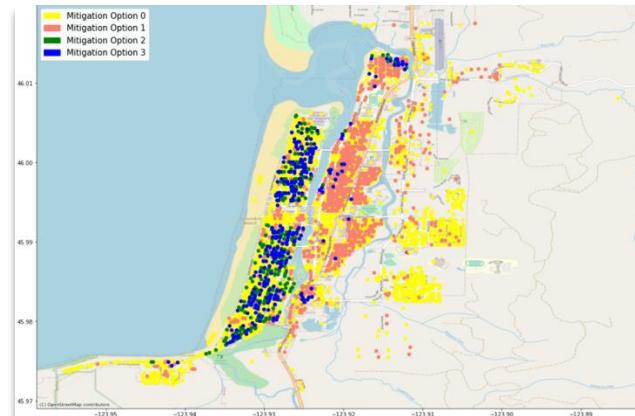
**Multiobjective optimization structure**

- Each performance metric represents an objective function

- Ability to prioritize objectives / assign weights

- Tradeoffs between different objectives

Collaborators: Dan Cox, Dylan Sanderson, Charles Nicholson, Tarun Adluri, Himadri Sen Gupta
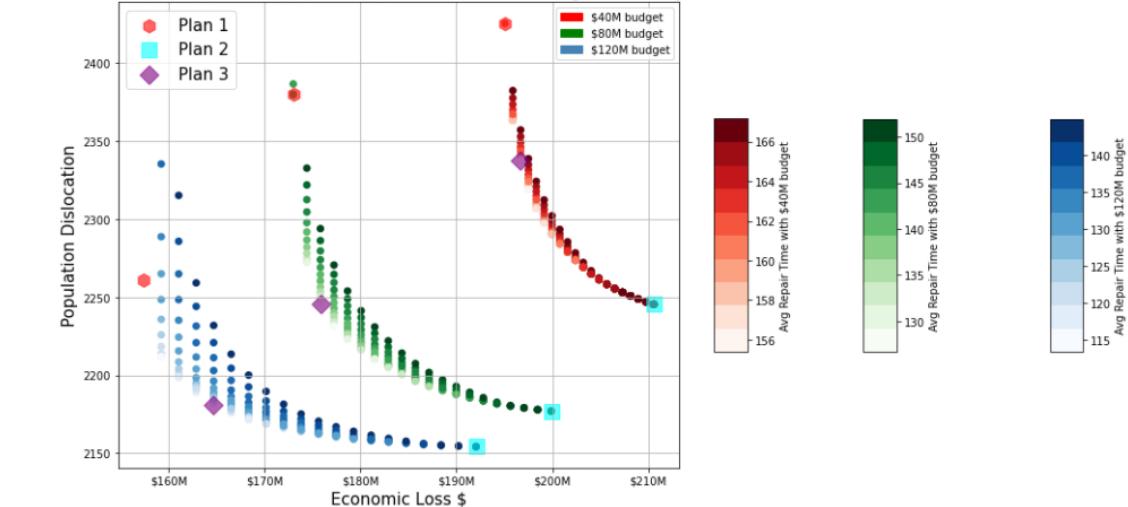




| Plan 1 | Plan 2 | Plan 3 |
|--------|--------|--------|
| Prioritizes economic loss | Prioritizes population dislocation | Prioritizes repair time |

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# MMSA (multilayer / multiscale)

- Recovery of interdependent infrastructure networks
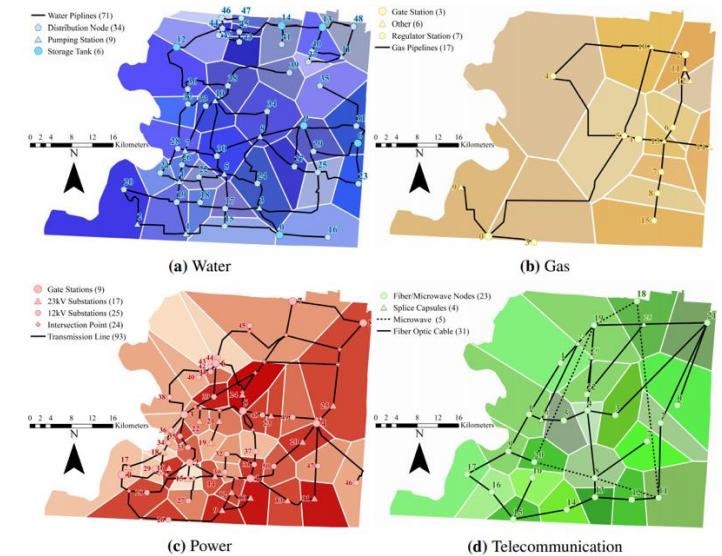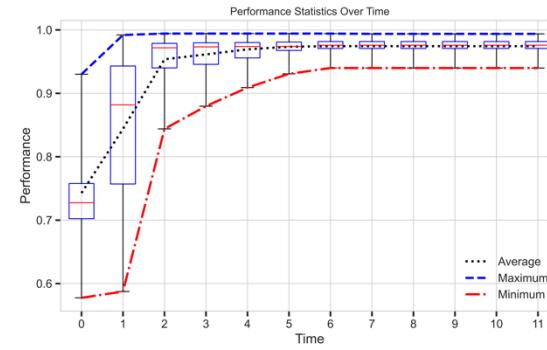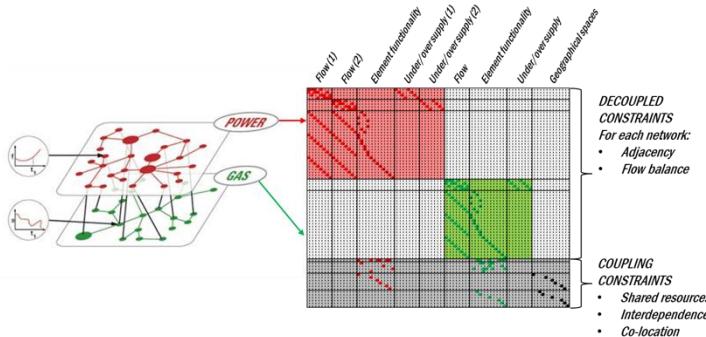




- Crew assignment and scheduling for multimodal transportation restoration

Collaborators: Jamie Padgett,
Sushreyo Misra, Anibal Tafur,
Leonardo Dueñas, Hesam Talebiyan



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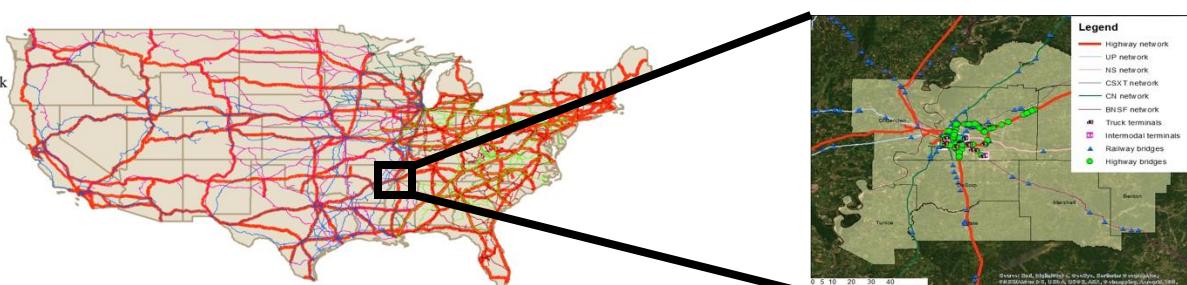
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# Joplin (tradeoffs between pre- and post-event investments)
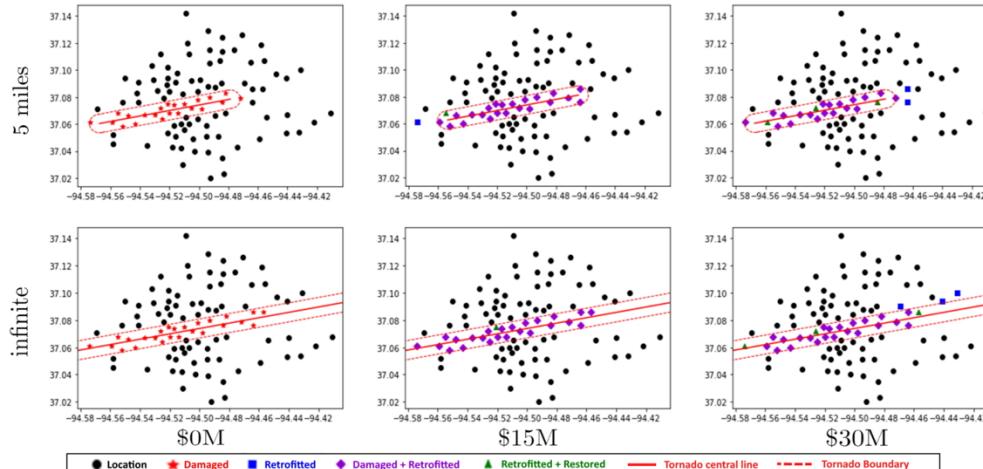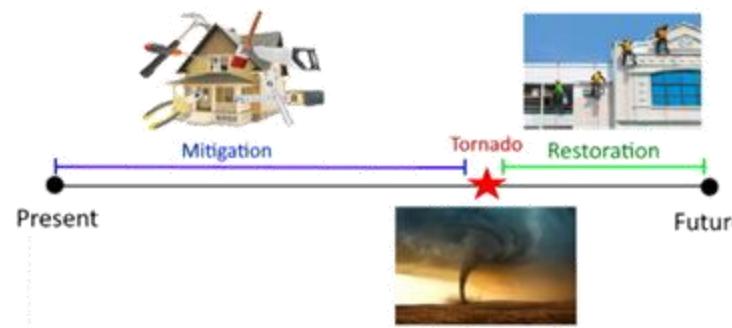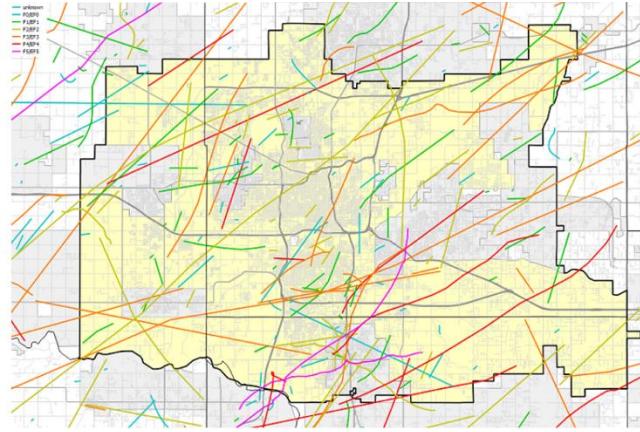


Collaborators: John van de Lindt,
Omar Nofal, Charles Nicholson,
Himadri Sen Gupta, Yunjie Wen, Juan
Borrero, Mehdi Ansari
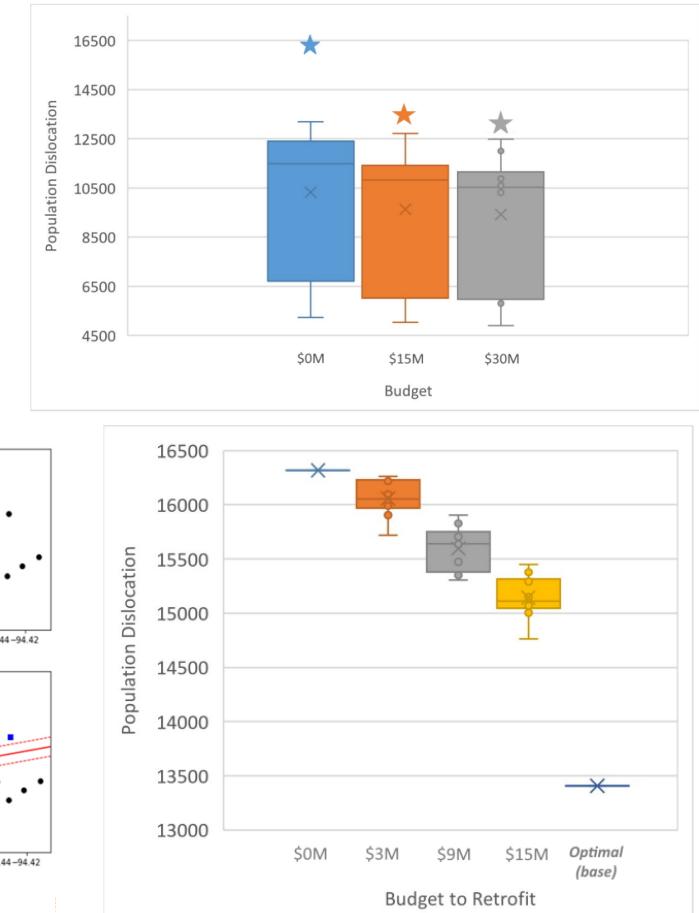
# Lumberton (hierarchical decision levels)
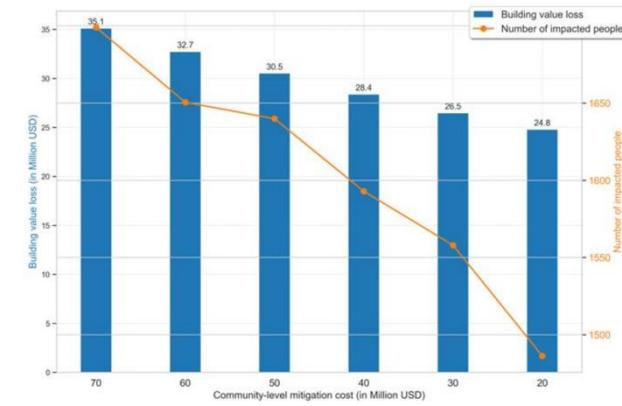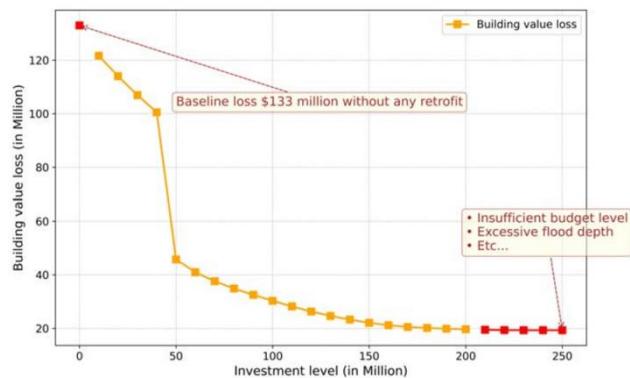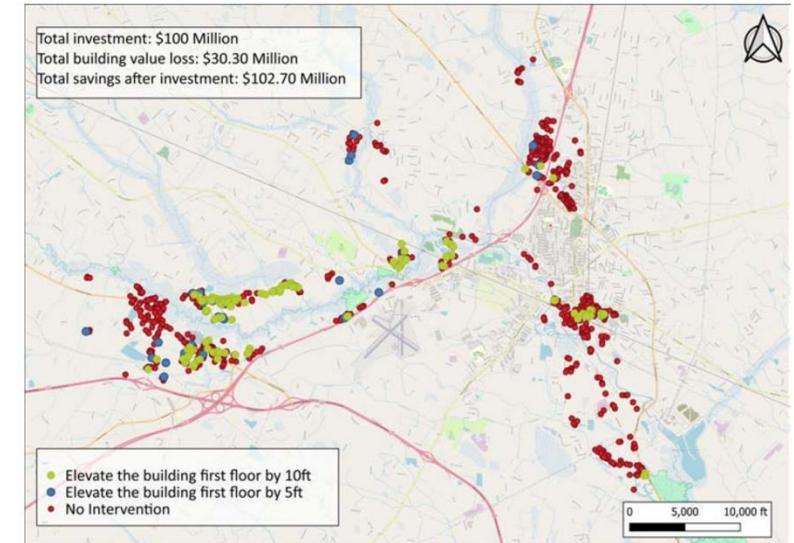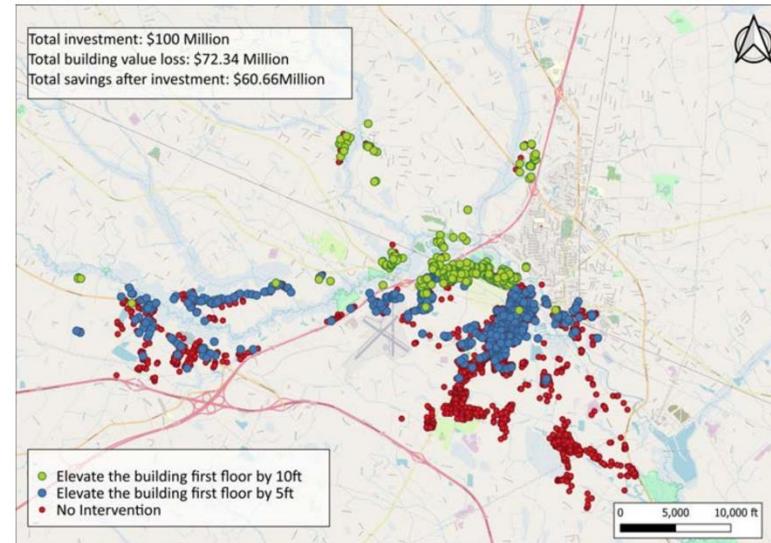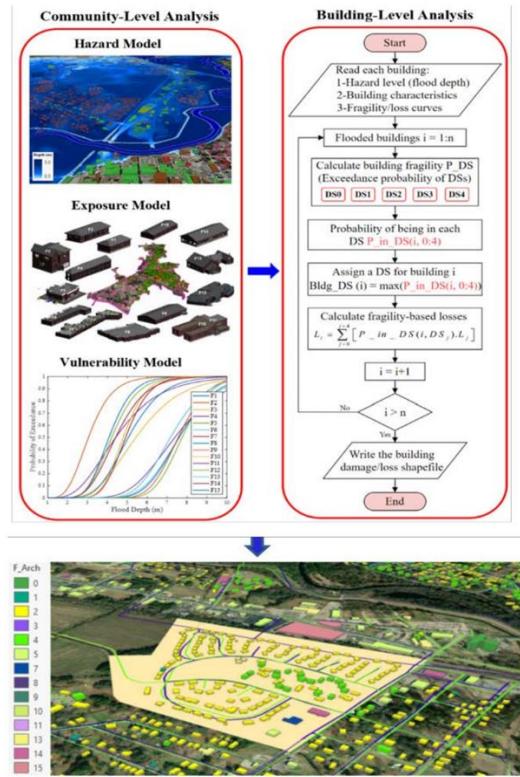


Collaborators: John van de Lindt, Omar Nofal, Charles Nicholson, Himadri Sen Gupta

# Social and economic equity in infrastructure networks



Met demand of Sector 1 (Agriculture)
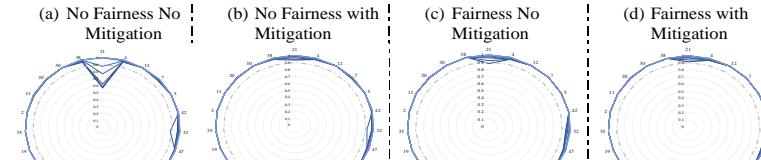
Met demand of Sector 2 (Mining)
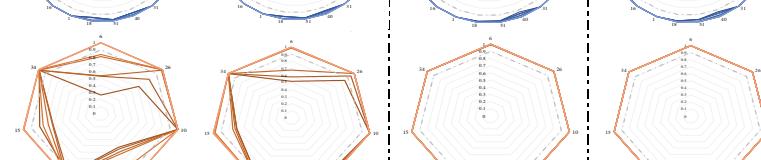
Met demand of Sector 3 (Construction)
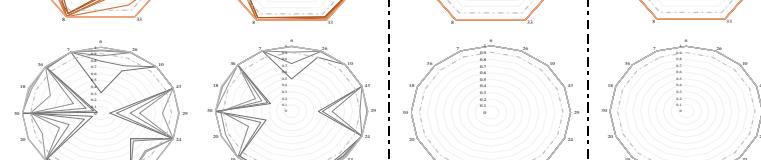
Met demand of Sector 4 (Manufacturing)
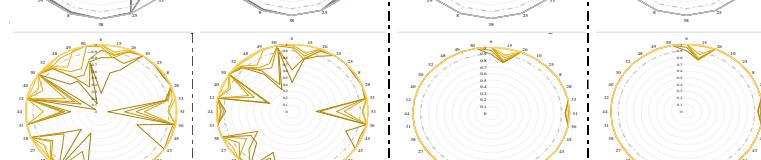
Met demand of Sector 5 (Commerce etc.)
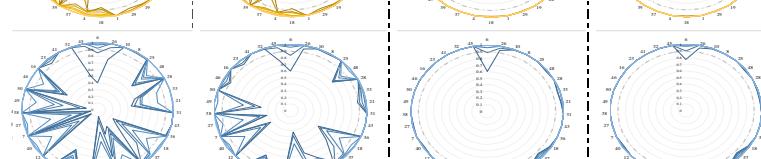
Met demand of Sector 6 (Transportation)

(a) No Fairness No Mitigation
(b) No Fairness with Mitigation
(c) Fairness No Mitigation
(d) Fairness with Mitigation

Without Fairness

With Fairness
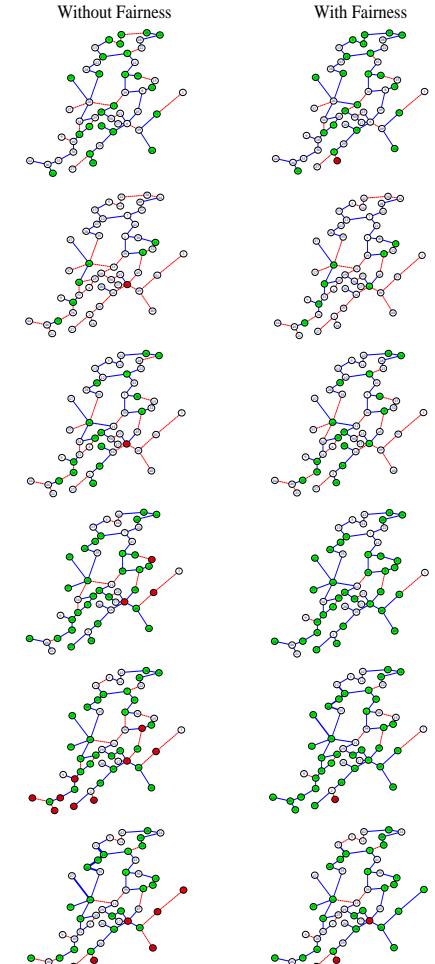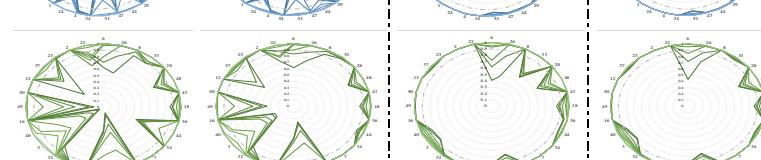
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# Opportunities and next steps

- Multiple hierarchal levels in decision-making
- Tradeoffs between performance metrics and equitability
- Diverse funding sources
- Temporally-dependent constraints
- Uncertainty
- Adaptability
- Decentralization