Mental Models for Improving Equitable Flood Mitigation in Southeast Texas

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Introduction

- Tools for equitable hazard mitigation are typically constructed top-down with little community input
  - Need to tailor tools to reflect local realities and facilitate local mitigation
- The people who best understand a given hazardscape are those who live within it
  - Government officials, nonprofit leaders, community and civic leaders, general public

What are community-identified drivers of flooding, flood mitigation, and flood recovery in Southeast Texas (SE TX)?

Study Area: SE TX

- Beaumont-Port Arthur Metropolitan Statistical Area
- Petrochemical and industrial hub
- Acute flood hazard
  - E.g., Hurricanes Harvey and Imelda
- Flood hazard expected to worsen with climate change, aging infrastructure, & continued urban expansion

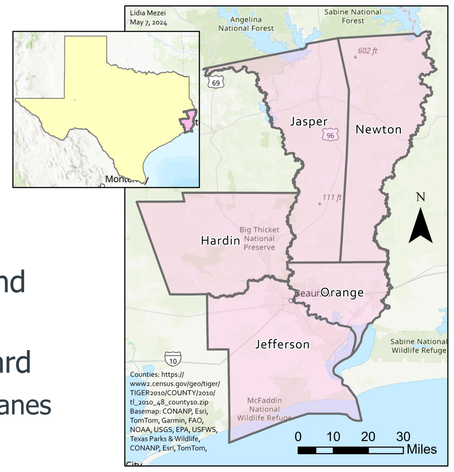


Fig. 1*. Map of 5-county study area.*

Method

- Fourteen semi-structured interviews with organization and community leaders focusing either on Beaumont (6) or Port Arthur (8)
- Interviews were transcribed and qualitatively coded for relationships among variables related to flooding and the direction (+: blue, -: orange) and strength (line width) of each relationship
- Coded relationships were "mapped" into Fuzzy Cognitive Maps (FCMs)
- **Fuzzy Cognitive Map (FCM)**: a type of causal network used to identify the impacts of suggested solutions to a problem based on the mental models of participants
- Example of qualitatively coded relationship:
  - From: Age of infrastructure
  - To: Efficacy of infrastructure
  - Directionality: Negative
  - Relationship strength: 0.25 Weak / A little

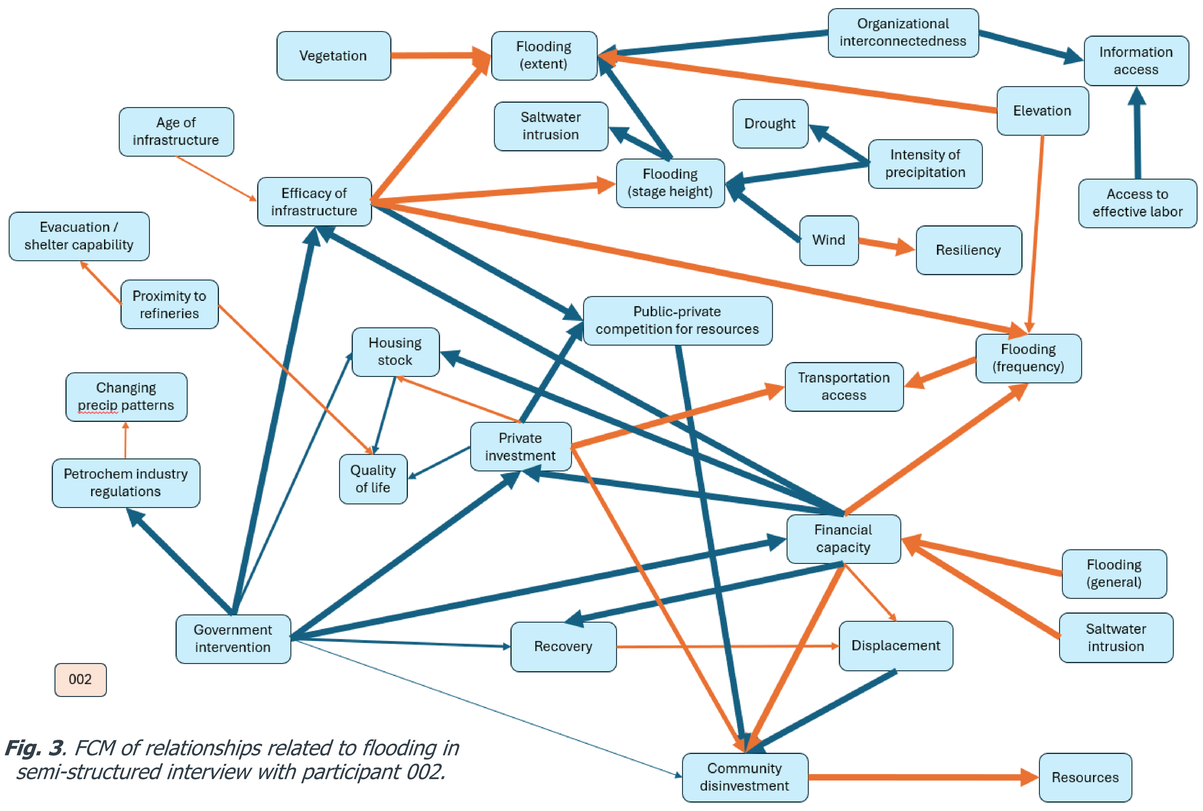


Fig. 3*. FCM of relationships related to flooding in semi-structured interview with participant 002.*

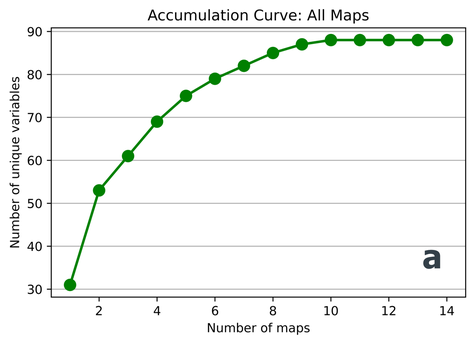
Preliminary Implications

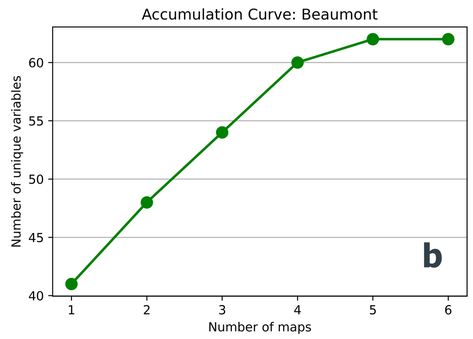
- For both Beaumont and Port Arthur,
  - Financial capacity is a central variable, indicating the importance of funding for government-driven flood mitigation projects as well as for individual flood insurance
  - Efficacy of infrastructure, especially drainage, is a key concern that may be leveraged through policy to alleviate flooding

Network Statistics

	Total	Beaumont	Port Arthur
# of interviews	14	6	8
Avg. # of variables	28.1	27.2	28.9
Standard deviation	± 6.8	± 8.1	± 6.1
Avg. density	0.10	0.09	0.11
Avg. # of Transmitter variables	12.9	12.0	13.5
Avg. # of Receiver variables	9.3	9.0	9.5
Avg. # of Ordinary variables	6.0	6.2	5.9

- On average, these FCMs have
  - Low density: they are sparsely connected on average with a relatively few number of causal relationships among variables
  - More transmitter variables than receiver variables: this can indicate "top-down" thinking of the system by participants
- All accumulation curves level off, indicating sufficient sampling





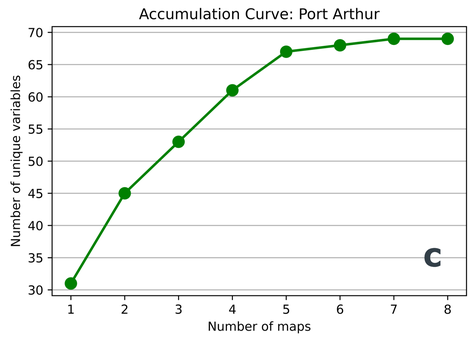


Fig. 4*. Accumulation curves of the number of unique variables in each collection of maps: a) all maps, b) Beaumont, c) Port Arthur.*

Next Steps

- Meet with interview participants to present the FCMs and receive feedback on the accuracy of perceived relationships
- Adjust FCMs to align with participant perceptions
- Distill the most important causal relationships from the FCMs
- Develop policy recommendation by "scenario testing" the effects of different policy options in each FCM by comparatively changing the influence of given nodes away from a base "static" state

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