Disaster-related accessibility to essential services: Testing location assumptions of food and shelter locations

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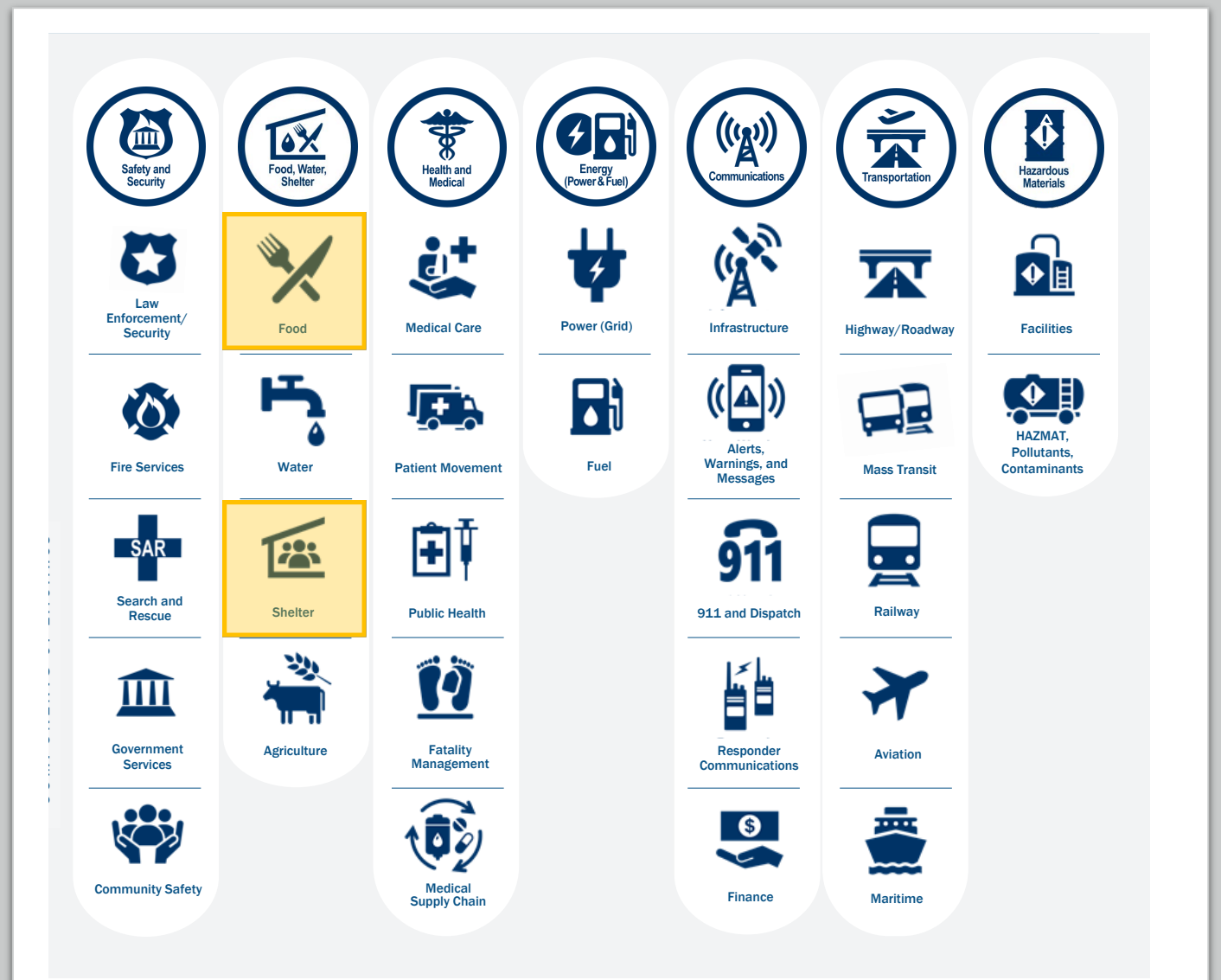
Emergency response plans include shelters and emergency food

- Shelter and food are among FEMA's community lifelines
- Some impacted persons rely on public shelters and emergency feeding
- American Red Cross (ARC) provided over 1M stays in 1 year period
- Where to locate essential services?



https://www.fema.gov/sites/default/files/documents/fema_community-lifelines-poster_102021.pdf

Shelter location models oversimplify behavior

Evacuating households make series of choices, including:

- accommodation type: family, friends, hotel, public shelter
- destination choice: physical location of selected accommodation

Existing models use **nearest-shelter** behavior assumption to locate shelters and assign people

- destination – *assignment* rather than *choice*
- ignores factors other than proximity to guide destination choice

Literature calls for shelter location models to make more realistic assumptions

This research tests nearest-shelter assumptions

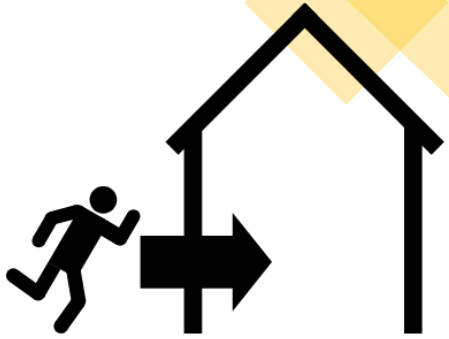
Focus on public shelters in local area

Three shelter configurations

- Actual historical response
- p-Center model – minimizes maximum household distance to nearest shelter
- p-Median model – minimizes average household distance to nearest shelter

For alternative configuration, examine:

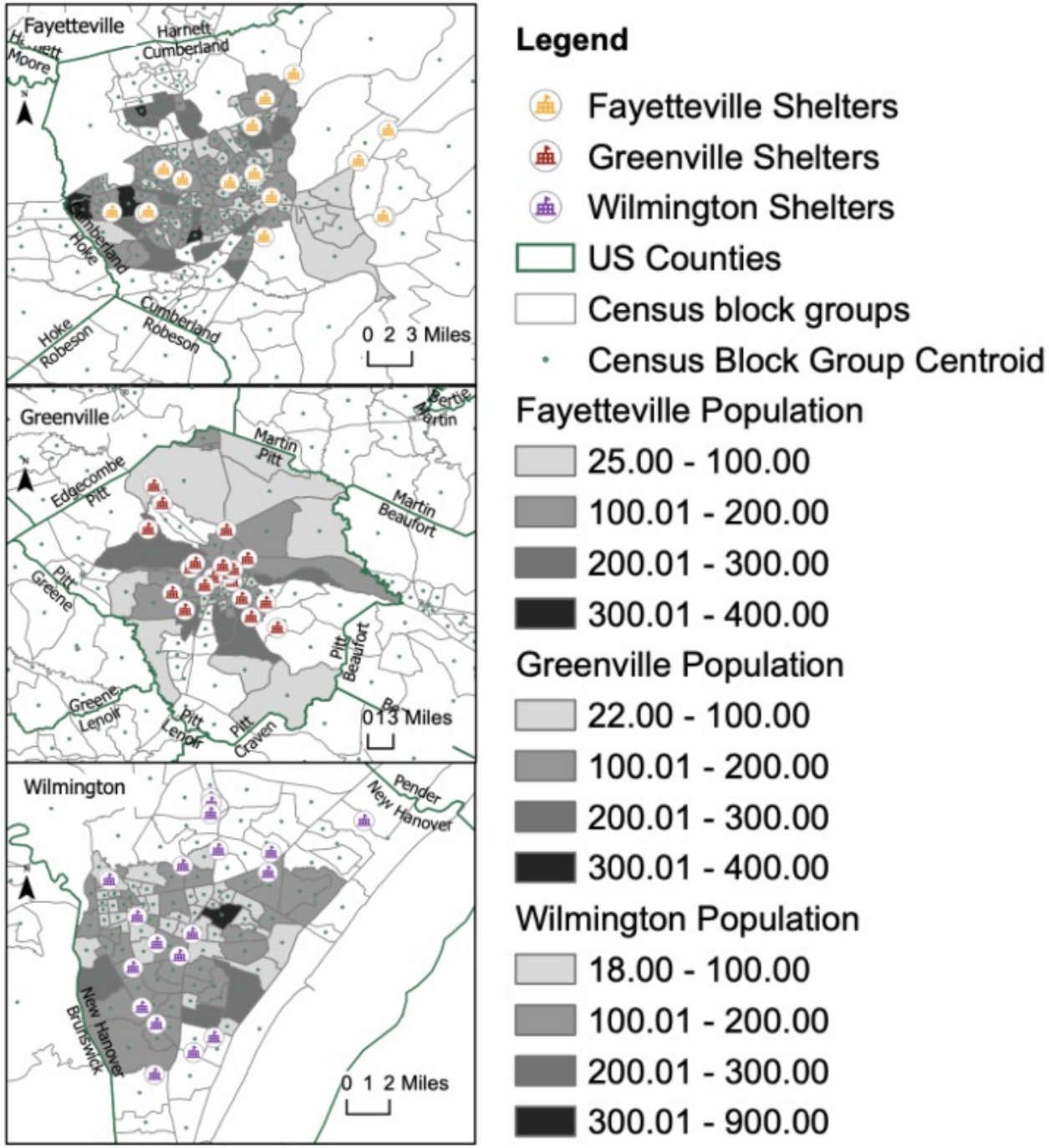
- Household distance to 1st-nearest shelter
- Incremental household distance to 2nd-nearest shelter
- Implications of nearest-shelter behavior on demand balance
- Nearest-shelter projections compared with actual overnight client counts



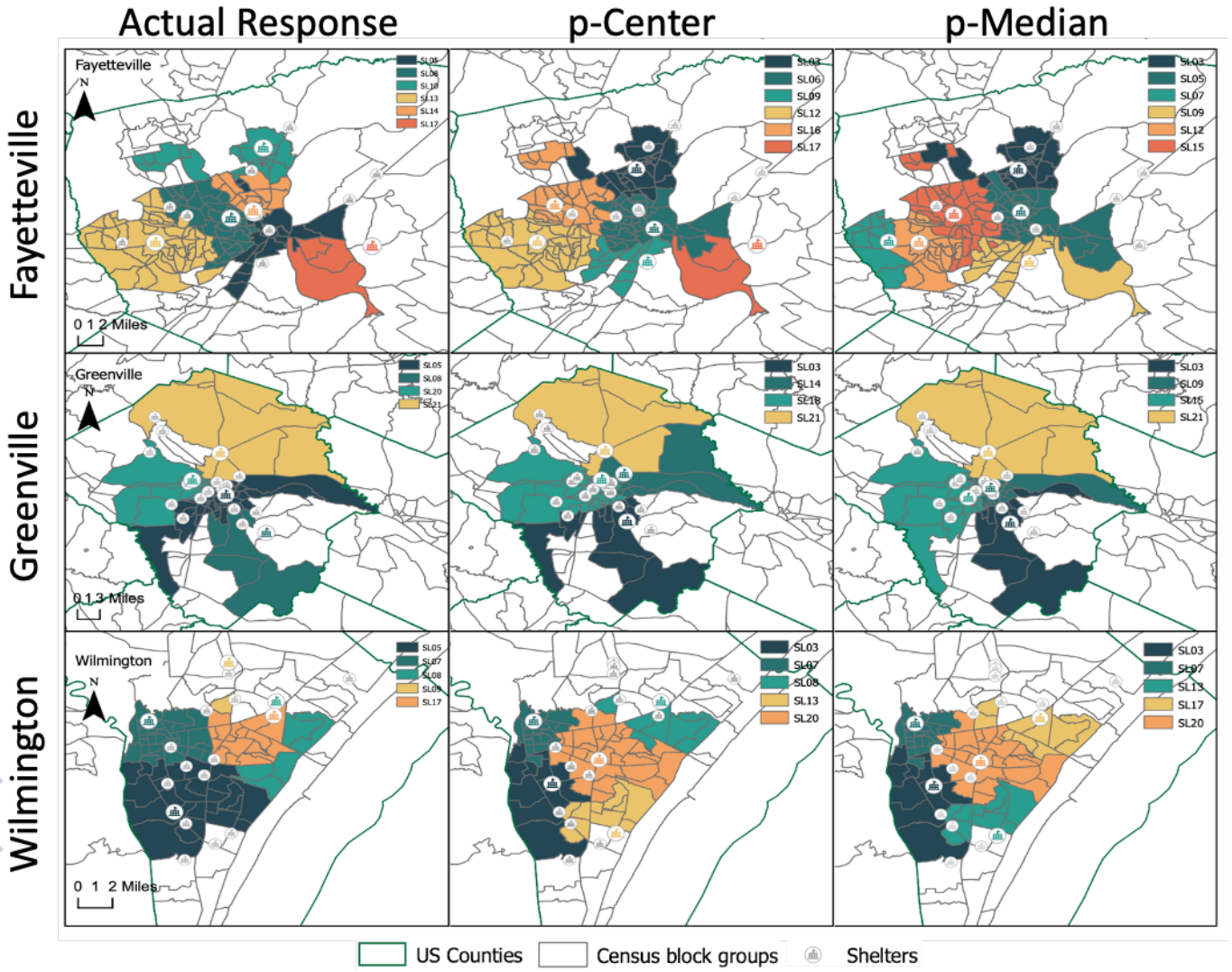
Does evidence support the nearest-shelter assumption?

Case Study
Hurricane Florence
North Carolina

- Selected cities: Fayetteville, Greenville, Wilmington
- Date range: Sep. 13-16, 2018
- Data:
  - Candidate shelter locations, ARC National Shelter System (NSS)
  - Open shelters, ARC NSS
  - Overnight client counts, ARC NSS
  - Census block group (CBG) population, American FactFinder
  - CBG geography, TIGER/Line dataset
  - Road distances, Google Maps API

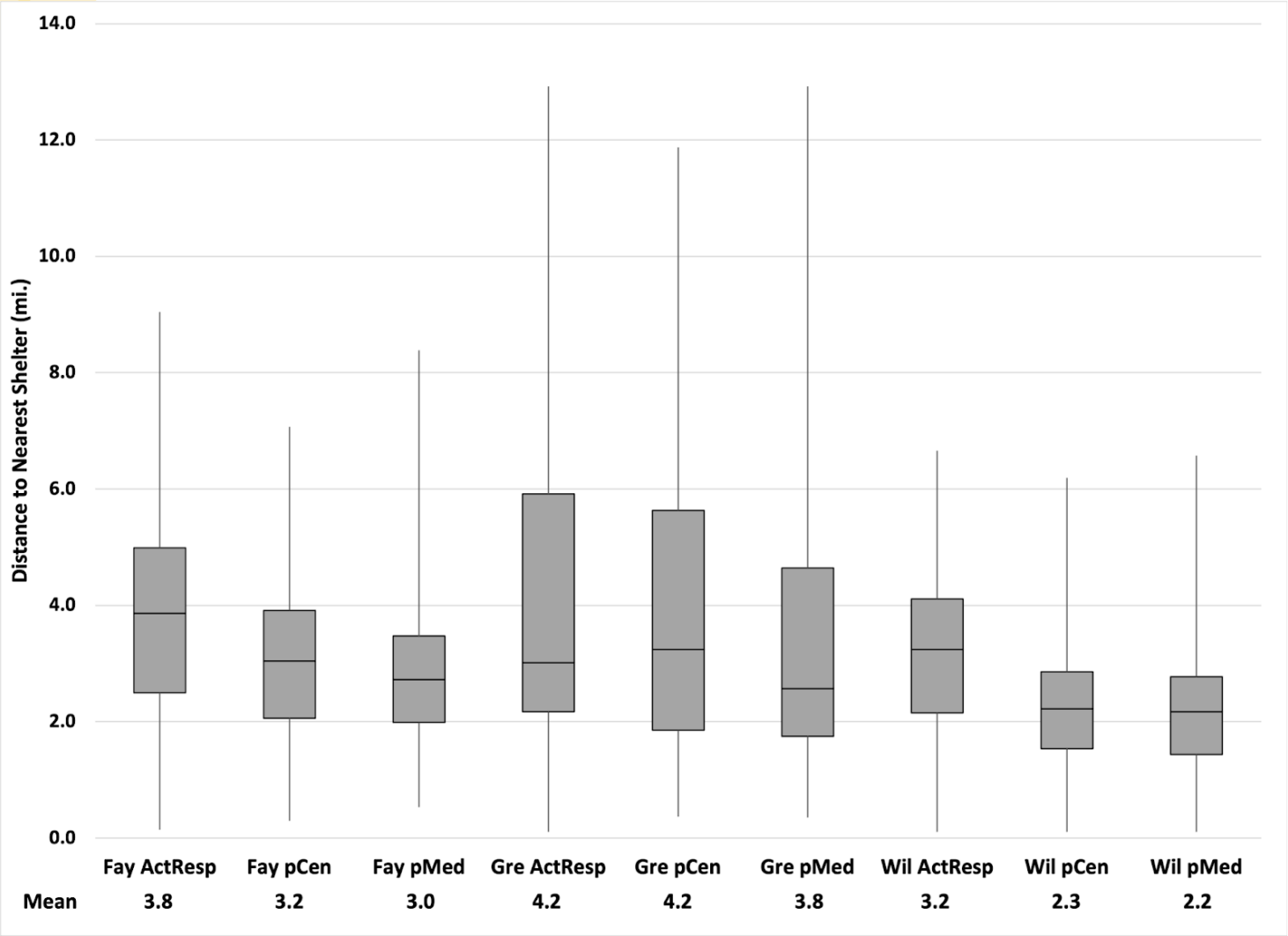


Case study shelter configurations



Actual Response	pCenter	pMedian
5, 8, 10, 13, 14, **17**	3, 6, 9, 12, 16, **17**	3, **5**, 7, 9, 12, 15
5, 8, 20, **21**	3, 9, 15, **21**	3, 14, 18, **21**
5, **7, 8**, 9, **17**	3, **7**, 13, **17**, 20	3, **7, 8,** 13, 20

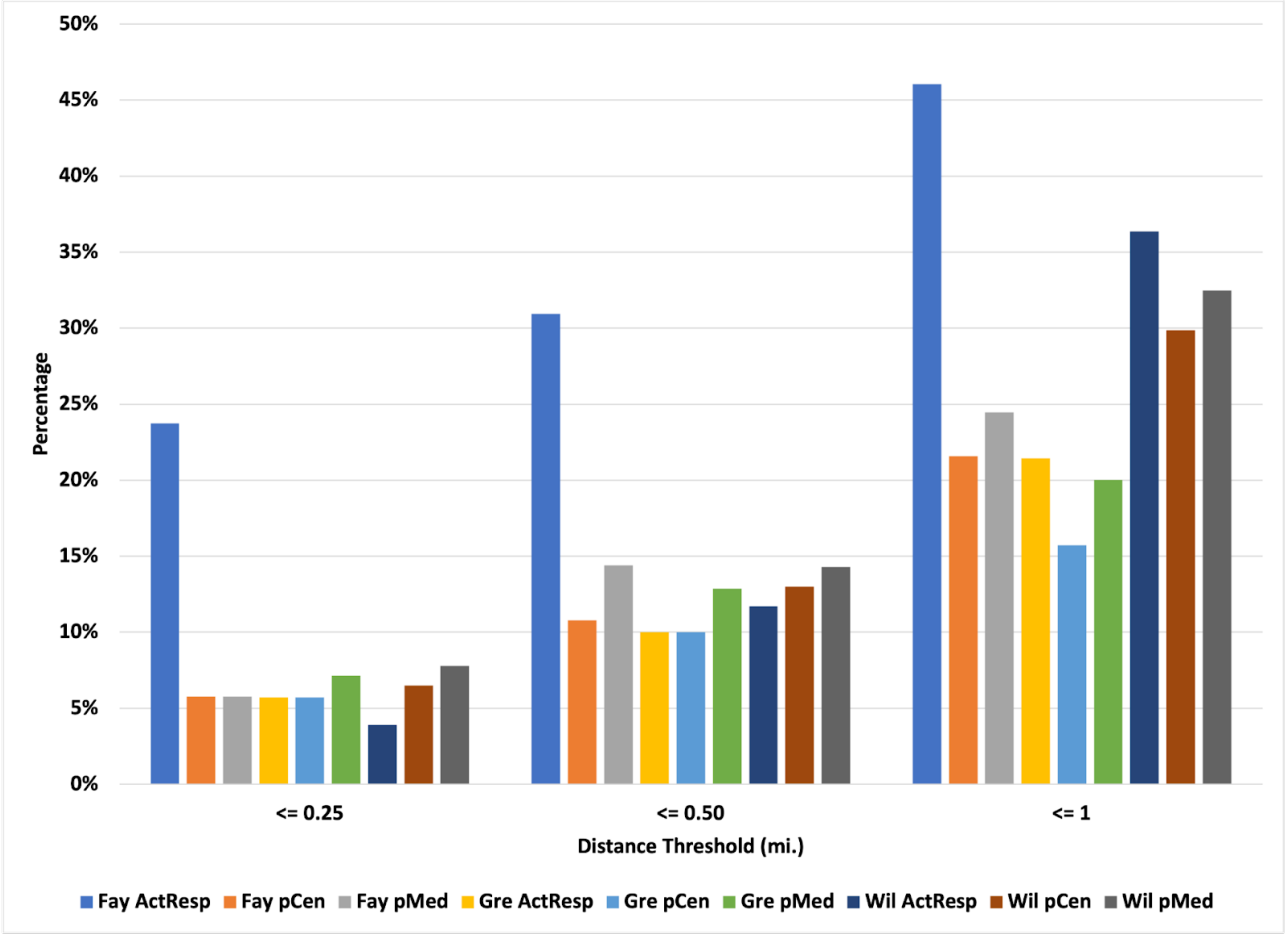
Household distances to nearest open shelter vary



- Range from 0.25 to 13 mi.
- Gray boxes show middle 50% of households
  - Fayetteville 2 to 5 mi.
  - Greenville 2 to 6 mi.
  - Wilmington 1.5 to 4 mi.
- Greenville has longest distances and more variation
- Models improve these metrics, over actual response

Many see low cost of choosing 2nd-nearest shelter

- Incremental distance from 1st- to 2nd-nearest shelter:
  - <= ¼ mi. for 3%-8% households
  - <= 1 mi. for 16%-36%
- Many more see low costs in Fayetteville Actual Response
  - <= ¼ mi. for 24%
  - <= 1 mi. for 46%
- Implies some households considering other factors do not “pay much” in proximity to choose farther shelters



Food Access

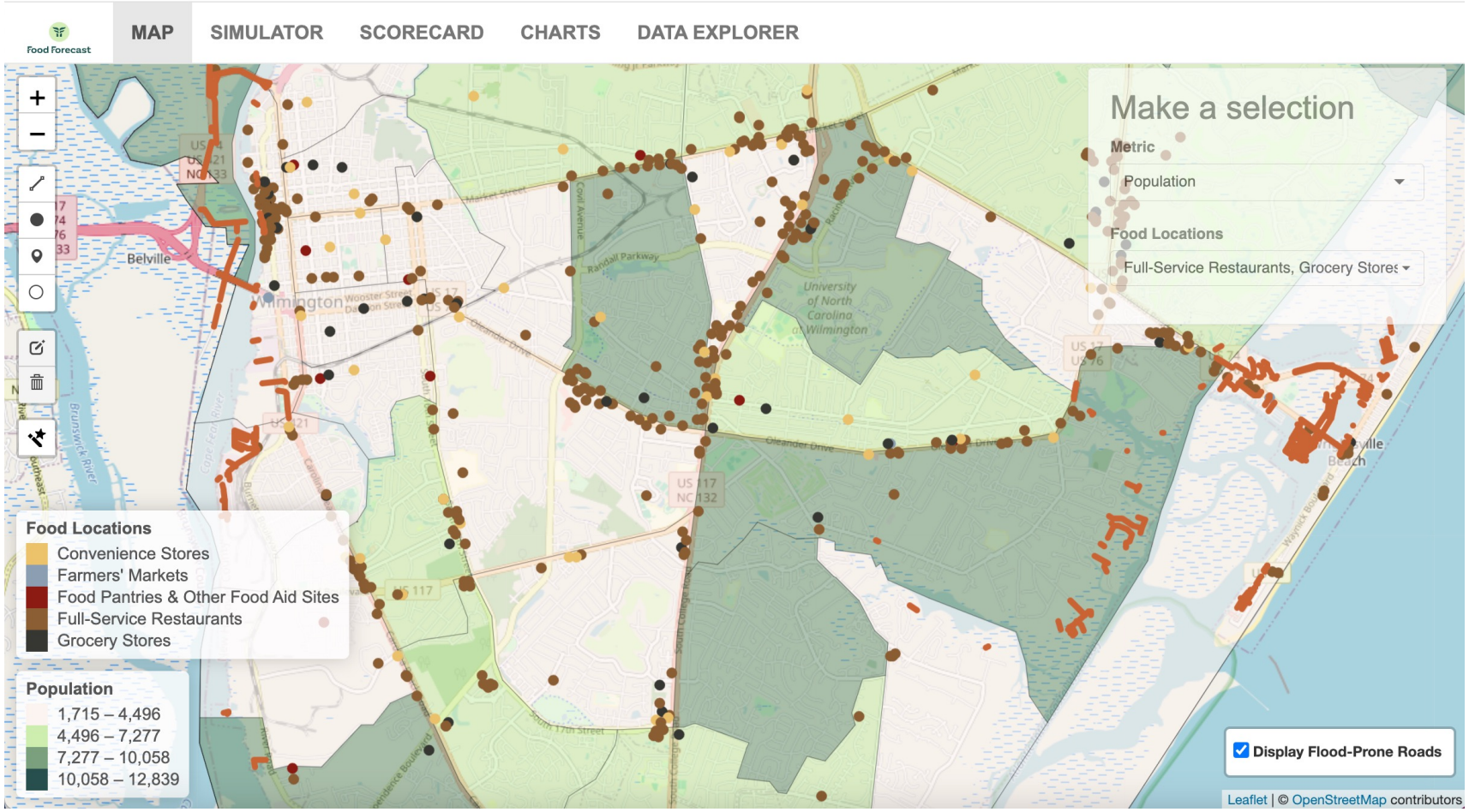
Goals

1. To understand how people access food sources during hurricanes
2. To describe how food access and availability are disrupted during hurricanes
3. To identify neighborhoods and populations most at risk for disruption to food security during hurricanes

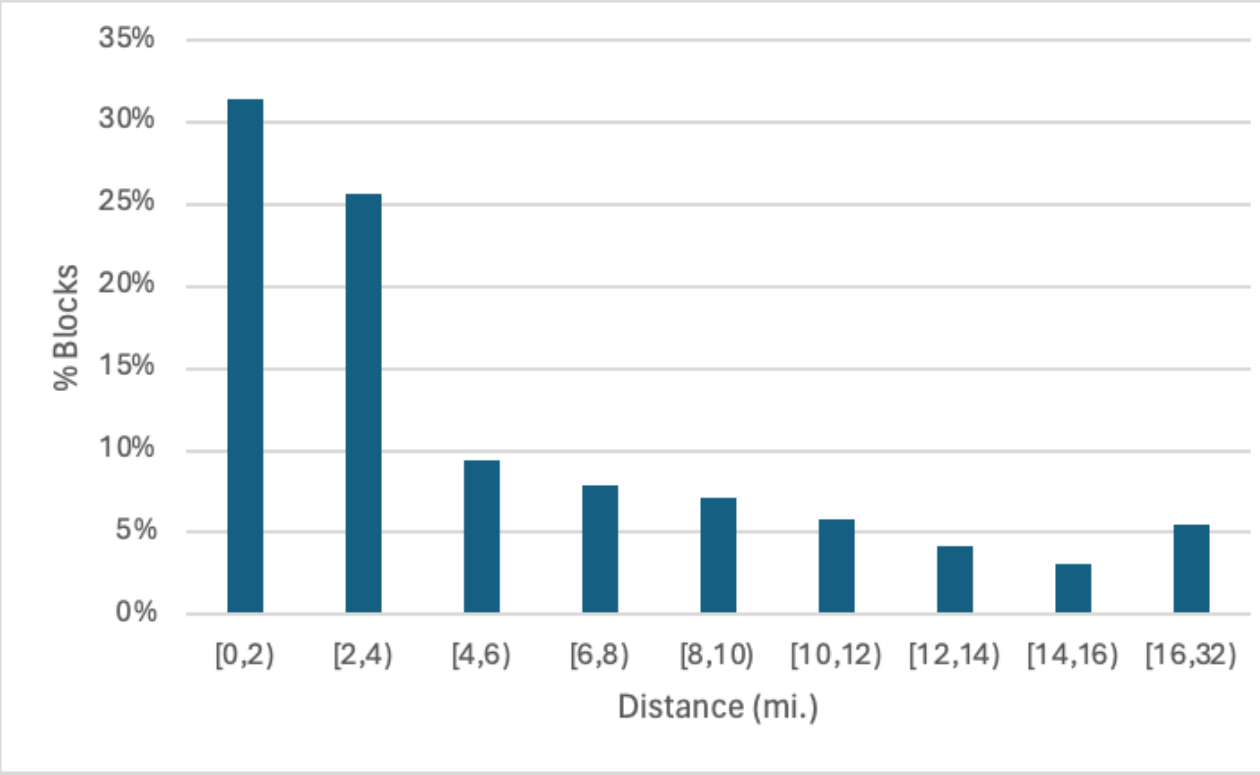
Case Study Hurricane Florence (2018) NC

Data sources

- Retail food stores: ReferenceUSA database
- Food Pantries: United Way of NC data, shared with research team
- Farmers Market: USDA



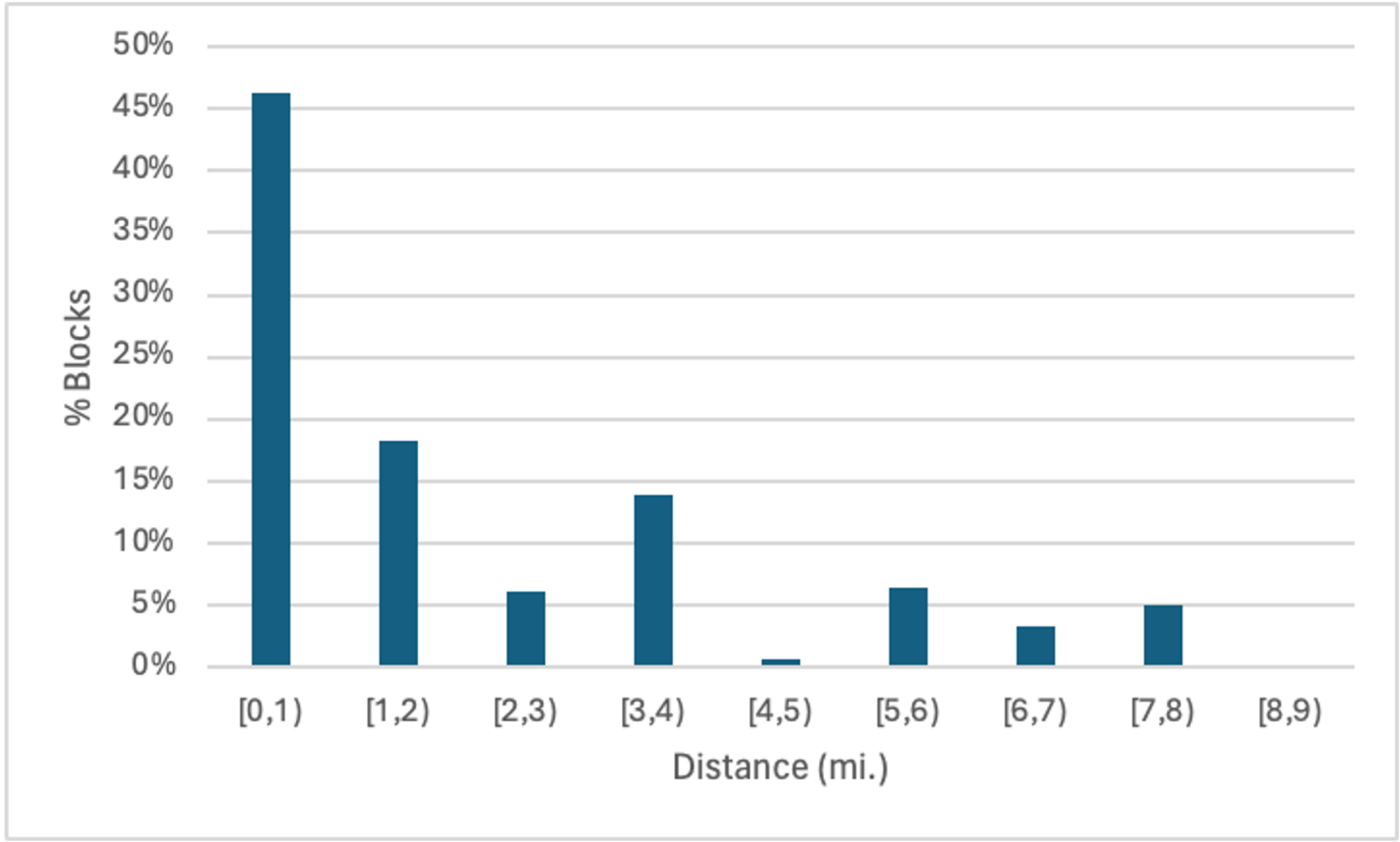
Distance from Block to Nearest Pantry



- ⅓ of blocks travel under 2 miles to reach nearest pantry
- An additional ¼ of blocks travel under 4 miles to reach nearest pantry
- Around ⅕ of blocks travel more than 10 miles to reach nearest pantry

Incremental Distance from Block to 2nd Nearest Pantry

- Almost ½ of blocks travel less than 1 mile farther than nearest pantry to reach second nearest pantry
- Almost ⅔ of blocks travel less than 2 miles farther than nearest pantry to reach second nearest pantry
- Only 1 block travels more than 8 miles farther (8.6 miles) to reach second nearest pantry



Next Steps…

1. Distance to nearest – grocery, convenience, dollar store, farmers market
2. How does power loss change travel time to nearest food source?
3. Which population (location, characteristics) are most impacted by disruption to food availability?

Partnership with USDA to also examine:

4. Which food sources are people accessing during the preparedness, response, and recovery phases?
5. What types of foods are people buying during the preparedness, response, and recovery phases?

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