

# AI Agents for Long-Term Disaster Recovery

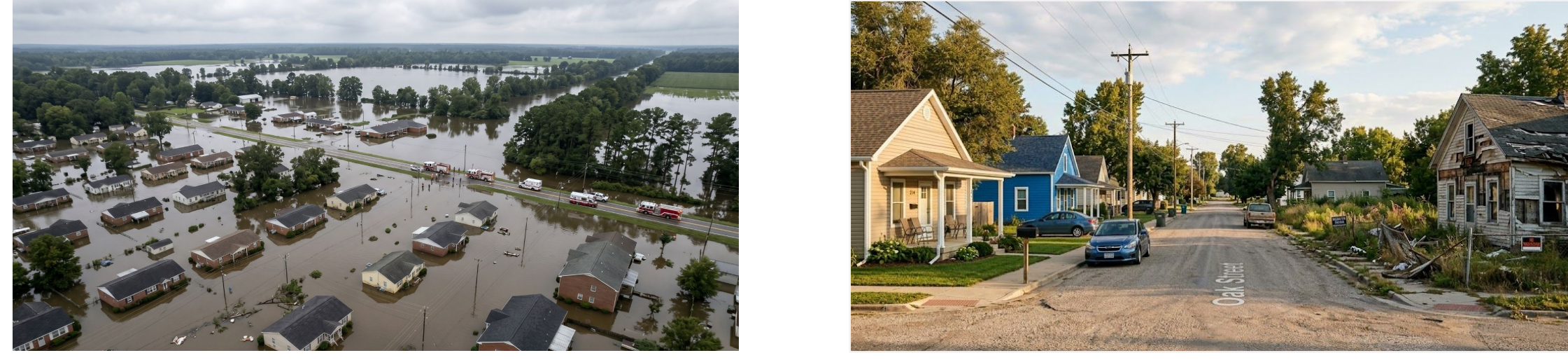
Supporting Vulnerability Assessment and Recovery Practice · A Lumberton, NC Case Study

Di Wang | University of Utah, Scientific Computing and Imaging Institute, Responsible AI Initiative | di.wang@utah.edu

## The Problem

When disaster strikes, federal aid arrives quickly. But recovery takes a decade — and recovery programs, and attention moves on long before communities do.

- Communities face:**
- Federal aid ends in 18–24 months — recovery takes a decade
  - No system tracks community conditions after programs close
  - The most vulnerable fall further behind, out of sight

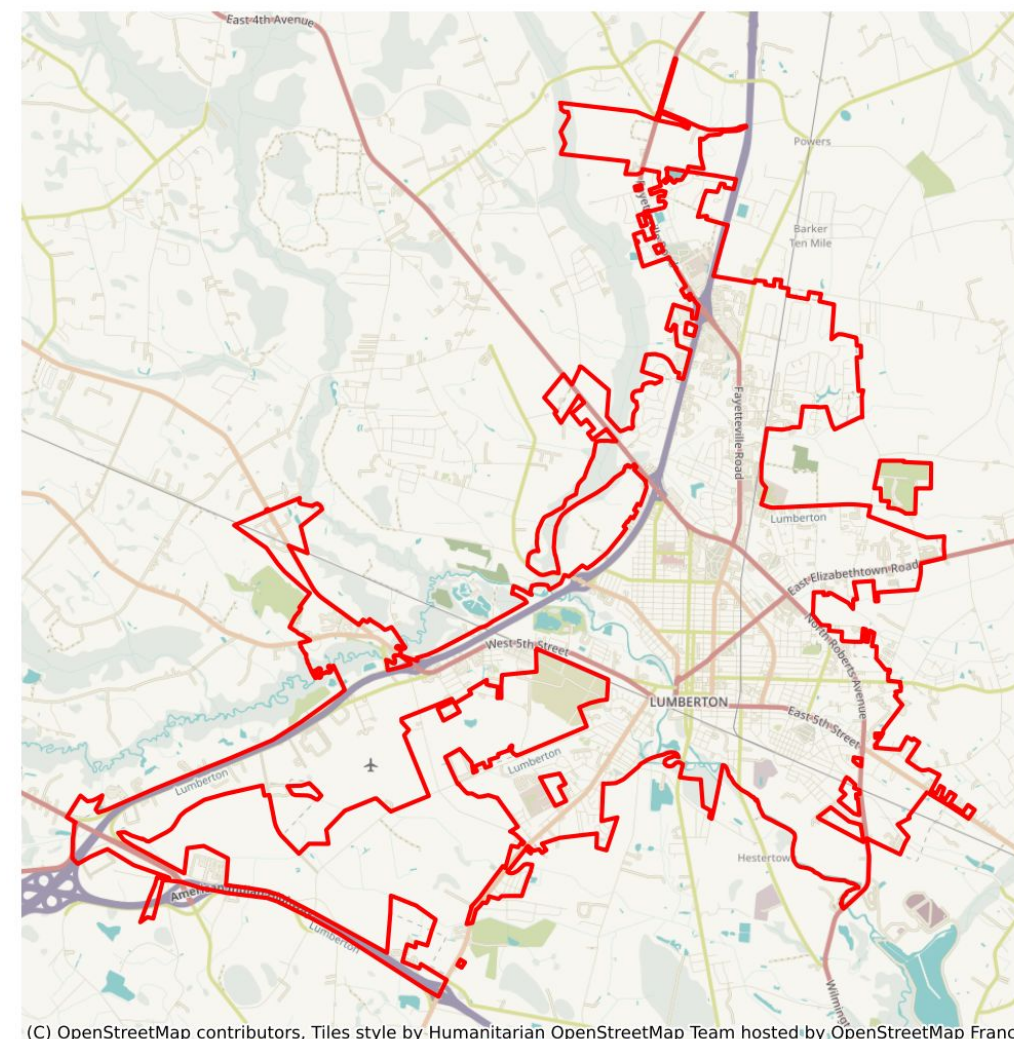


## Case Study — Lumberton, NC

**Deeply vulnerable before the first storm:**  
35% poverty, \$17,500 per capita income, 70% minority population (2015)

**Two floods, no gap to recover:**  
Matthew (Oct 2016), then Florence (Sep 2018) before Matthew assistance closed

**Eight years on: no strong recovery signal:**  
Population ~13%, housing burden unchanged, hardest-hit area: poverty 29%→42%



## Data Foundation

### Census Vulnerability Data

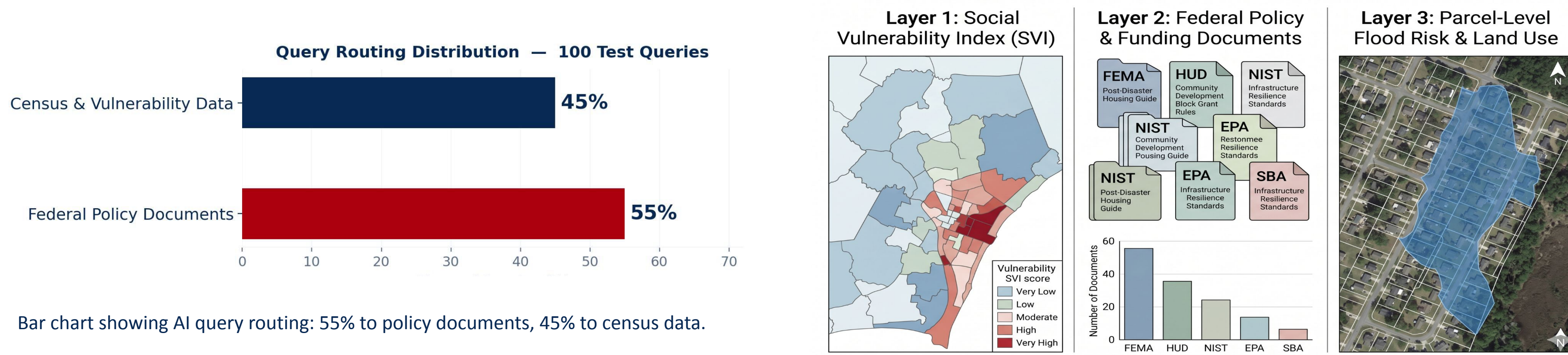
American Community Survey (ACS) vintages (2015–2024) · 17 Robeson County tracts  
50 Social Vulnerability Index (SVI) indicators (poverty, housing burden, unemployment, disability, mobility)

### Policy Corpus — 85+ Official Documents, 352 Records

FEMA (29) · National Institute of Standards and Technology (NIST) (21) · HUD (16) · 12+ agencies  
5 authority tiers from binding federal regulations to recommended practice · Full disaster lifecycle coverage

### Image and Geospatial (On-going)

Parcel records · FEMA flood zones · National Agriculture Imagery Program (NAIP) pre/post imagery · OpenStreetMap building footprints



## Pipeline vs. Generic AI— Why Grounding Matters

A general-purpose AI can answer recovery questions — but without access to local data or authoritative documents, its answers are not verifiable.

This system grounds every response in real census records and official federal policy, making outputs auditable and actionable.

Generic AI	This Pipeline
<p>Q1: Which neighborhoods in Lumberton should get housing repair funding first?</p> <p>✗ Communities with high poverty and housing damage are typically prioritized. Areas with low-income households and significant flood impact should be considered first.</p>	<p>✓ Southwest Lumberton ranks #1 — 64.3% of residents below 150% of the federal poverty level, 39.4% of households spending more than 30% of income on housing, median home value \$74,100. Source: ACS 5-year estimates, Census Tract 960801, 2023.</p>
<p>Q2: How has housing affordability changed in Downtown Lumberton since Hurricane Matthew?</p> <p>✗ Recovery programs typically reduce housing cost burden over time as households stabilize and federal assistance takes effect.</p>	<p>✓ Housing cost burden in Downtown Lumberton improved from 34.2% in 2015 to 23.5% by 2021 — a positive recovery signal. But poverty rebounded to 31.4% in 2023 (near its post-Matthew peak), while median home values jumped 24% in two years (\$125,600 in 2021 → \$155,800 in 2023) — a displacement risk signal. Source: ACS 5-year estimates, Census Tract 960900, 2015–2023.</p>
<p>Q3: How did Lumberton's housing stock change after Hurricane Matthew and Hurricane Florence, and has it recovered?</p> <p>✗ Lumberton's housing stock was fundamentally altered by the compounding impacts of Hurricane Matthew and Hurricane Florence. While some sectors of the housing market have stabilized, the city's affordable housing footprint has not fully recovered, instead undergoing a long-term shift away from the most vulnerable flood zones.</p>	<p>✓ Lumberton lost 346 housing units between 2015 and 2024, with mobile homes accounting for nearly all of that decline — falling from 829 to 521 units (9.6% to 6.3% of stock) — while median rents rose from \$649 to \$866 and 36.1% of remaining households are housing burdened. Source: ACS 5-year estimates, Robeson County census tracts, 2015–2024.</p>
<p>Q4: What share of beneficiaries must be low-income for a Community Development Block Grant (CDBG)-funded project to qualify?</p> <p>✗ CDBG programs generally require that activities primarily benefit low- and moderate-income people, though the exact threshold may vary by activity type and state guidelines.</p>	<p>✓ At least 51% of persons benefited must be low- and moderate-income (at or below 80% of area median income). The service area must be primarily residential and meet threshold. Source: 24 Code of Federal Regulations (CFR) Part 570 Subpart I, p.10.</p>

## Scalability

**Designed to generalize** — deploying for any US jurisdiction requires adding the census data and policy corpus, with no changes to core architecture.

**Geographic** — any US jurisdiction with ACS coverage (all 73,000+ census tracts)

**Corpus** — policy library can be extended with state, county, or program-specific documents

**Data agents** — new agents (damage assessments, permit records, utility data) plug into the existing pipeline

## Applications

### 1 For practitioners in the field

- Quickly screen neighborhoods for program eligibility
- Answer household-level questions about program options during intake
- Pull regulatory requirements on demand during grant writing

### 2 For researchers and planners

- Track recovery trajectories across census vintages for any jurisdiction
- Compare vulnerability trends before and after a disaster event
- Identify which populations are falling behind after programs close

### 3 For policy and program design

- Audit whether recovery investments reached the most vulnerable tracts
- Surface gaps between where federal programs were active and where need persisted
- Build evidence base for future CDBG-DR allocation arguments

## Contributions

**Modular multi-agent pipeline** — routes natural language recovery questions to census, policy, or geospatial agents with no coding required

**Authority-tiered policy corpus** — 85+ federal documents across 12+ agencies, ranked by normative force and lifecycle phase for citation-verified retrieval

**Longitudinal multi-domain vulnerability dataset** — Census data (2015–2024) across SVI indicators to enable tract-level recovery monitoring unavailable from any single federal source

## On-going Tasks & Future Goals

**Geographic Information System (GIS) Agent (next priority):**



**Multi-community rollout:**

Replicate to disaster-affected jurisdictions across NC; validate routing accuracy across diverse recovery contexts.

**Practitioner dashboard:**

Map-based interface for tract-level vulnerability rankings, policy citations, and parcel overlays.

## Live Demo & Feedback

This system is under active development.

Scan to share what recovery questions matter most to your work.



Tried it? Share what worked, what didn't, and what recovery questions matter most to your work. Your feedback directly shapes the next version.

Interested in piloting this system for your community or research? We'd love to hear from you.

## Contact Information

Di Wang, Postdoc  
di.wang@utah.edu  
University of Utah  
Scientific Computing and Imaging Institute  
One-U Responsible AI Initiative

Divya Chandrasekhar, Associate Professor  
d.chandrasekhar@utah.edu  
University of Utah  
Department of City & Metropolitan Planning

Natural Hazards Workshop 2026  
Poster Presentation

Seeking collaborators from recovery practice, policy, and research — and communities interested in piloting the system. Feedback from practitioners is especially welcome.

