

A Multiscalar Index of Social Vulnerability for the United States

Joseph V. Tuccillo

Geospatial Science and Human Security Division,
Oak Ridge National Laboratory

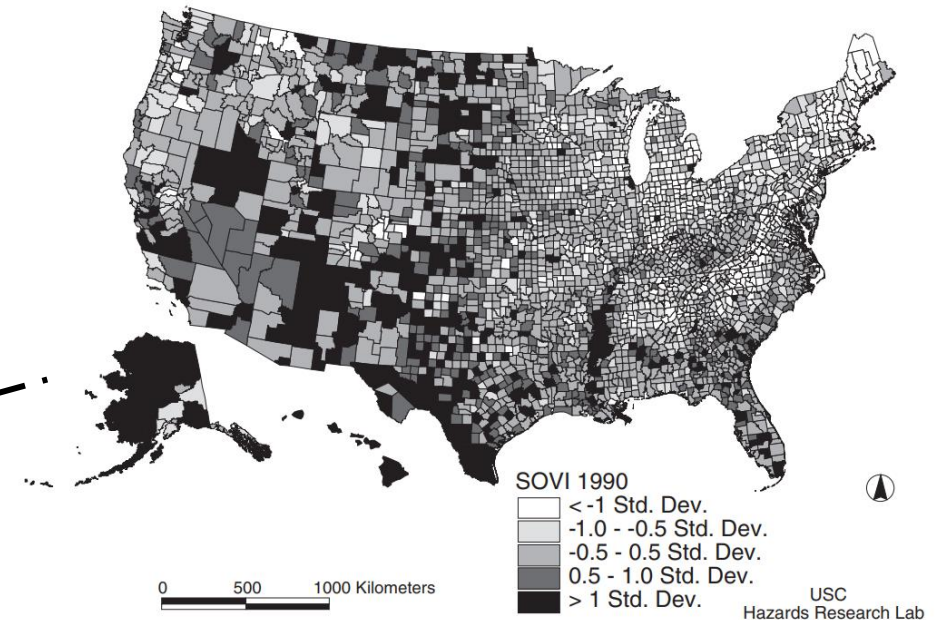
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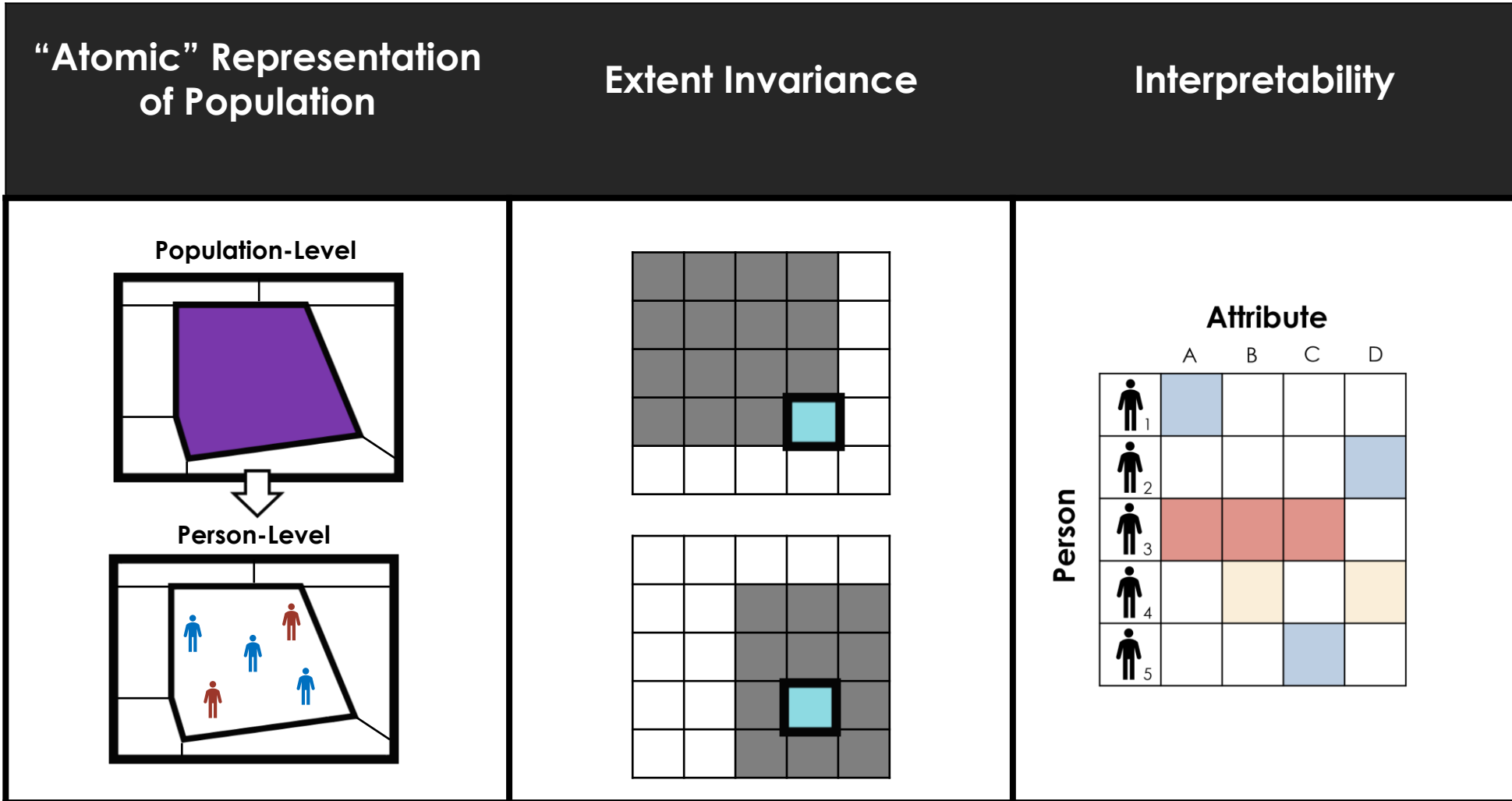
Social Vulnerability

- Collective risk of impacts from disturbances/stressors [1, 2]
- Applications in natural hazards, environmental justice, social determinants of health
- **Spatial indices of social vulnerability** built on summary (population) level census statistics



Cutter et. al 2003 [3]

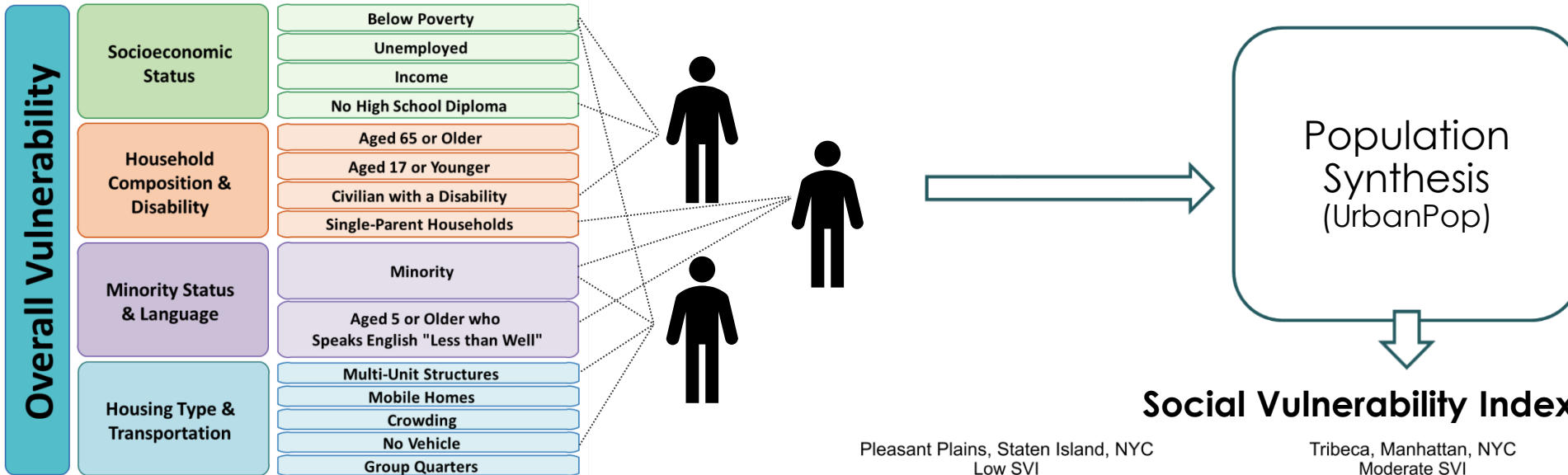
Enhancing Social Vulnerability Metrics



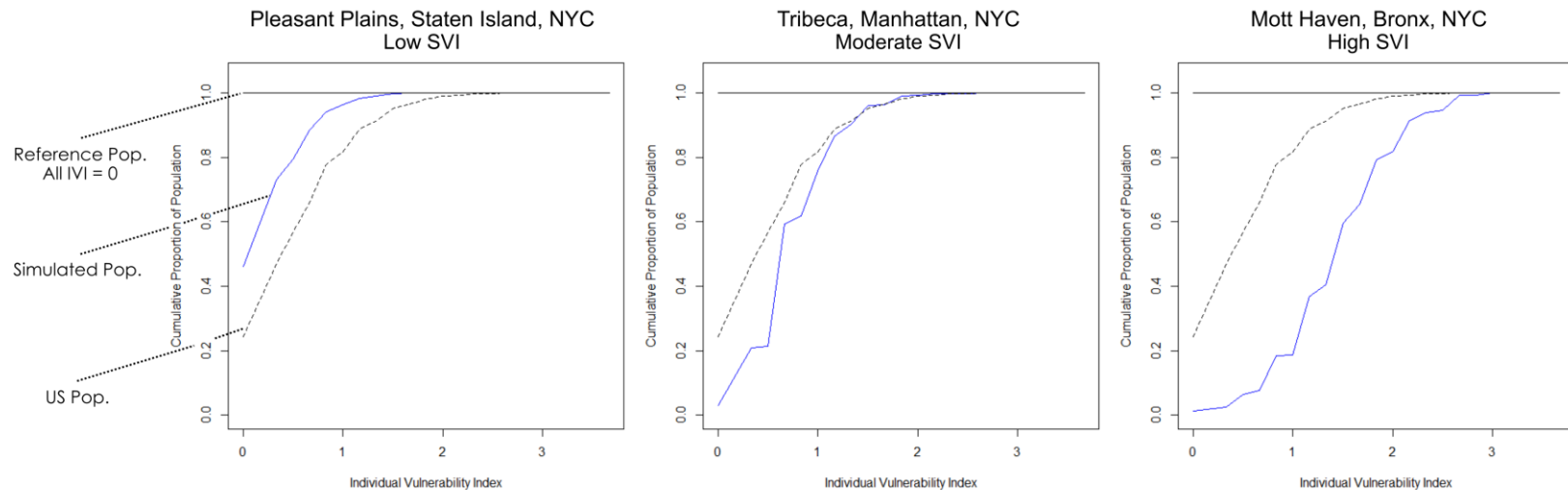
Individual-Oriented Social Vulnerability Index (IOSVI)

Individual Vulnerability Index (IVI)

Adapt indicators to ACS PUMS → Score Respondents

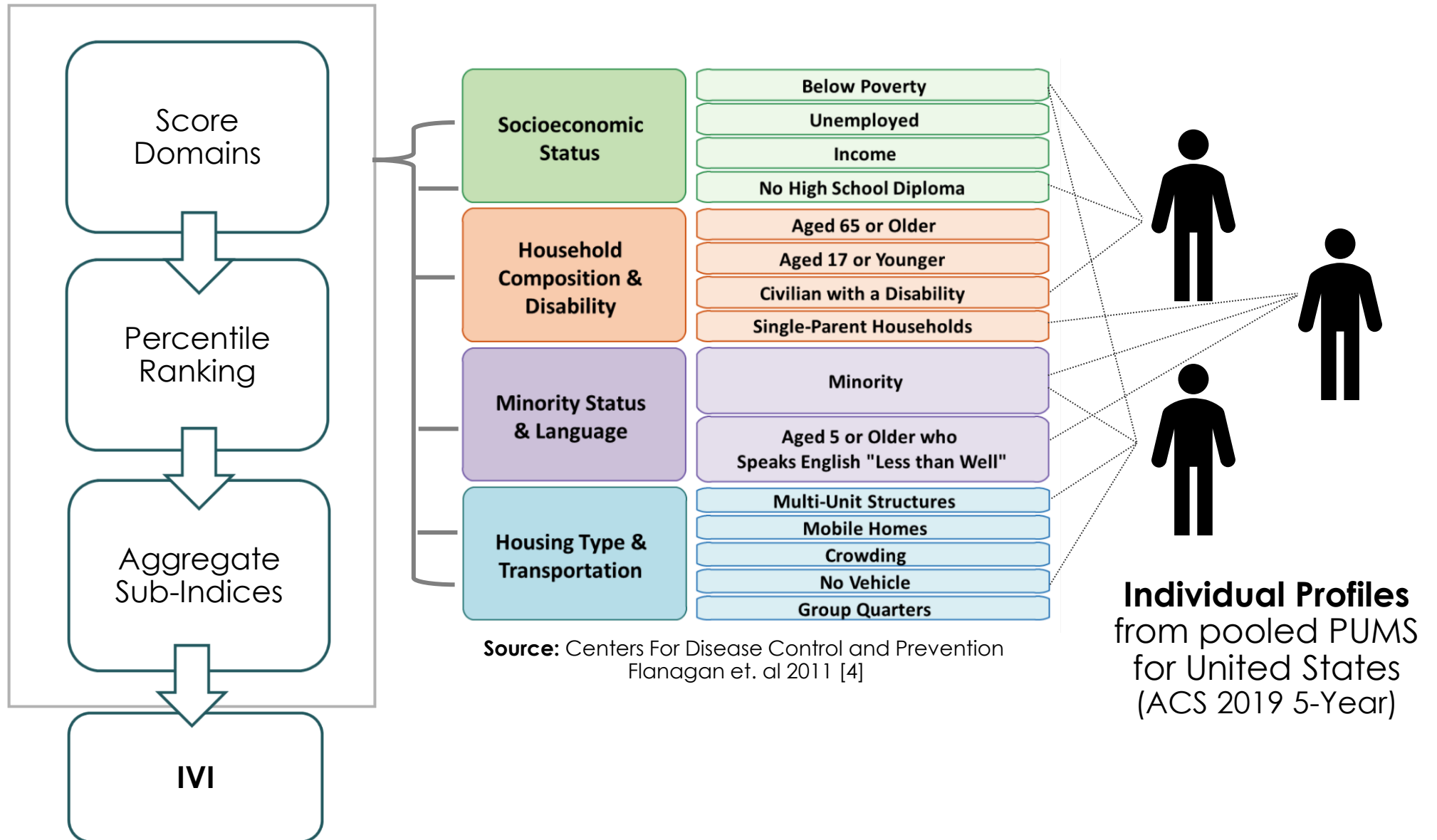


Source: Centers For Disease Control and Prevention
Flanagan et. al 2011 [4]

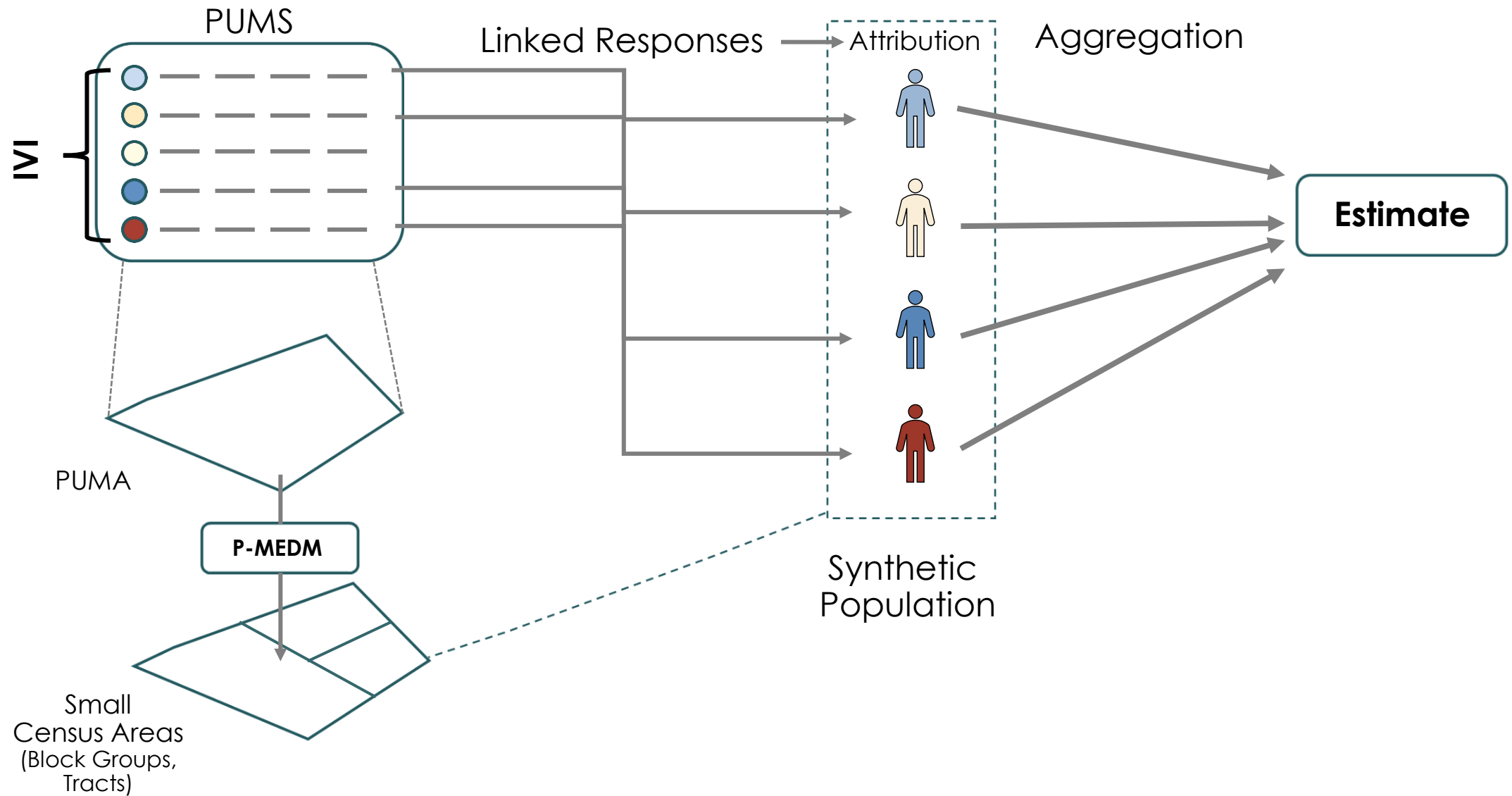


SVI Computation on UrbanPop synthetic populations for 3 census tracts in New York City.

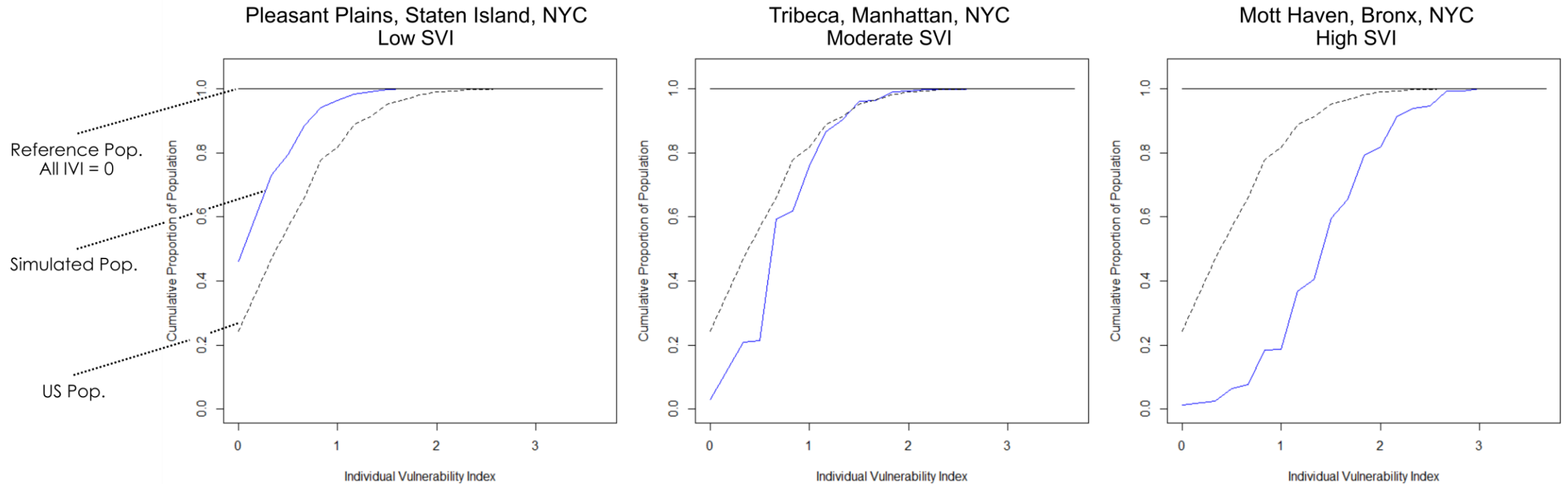
Computing the Individual Vulnerability Index (IVI)



UrbanPop: Spatializing the IVI

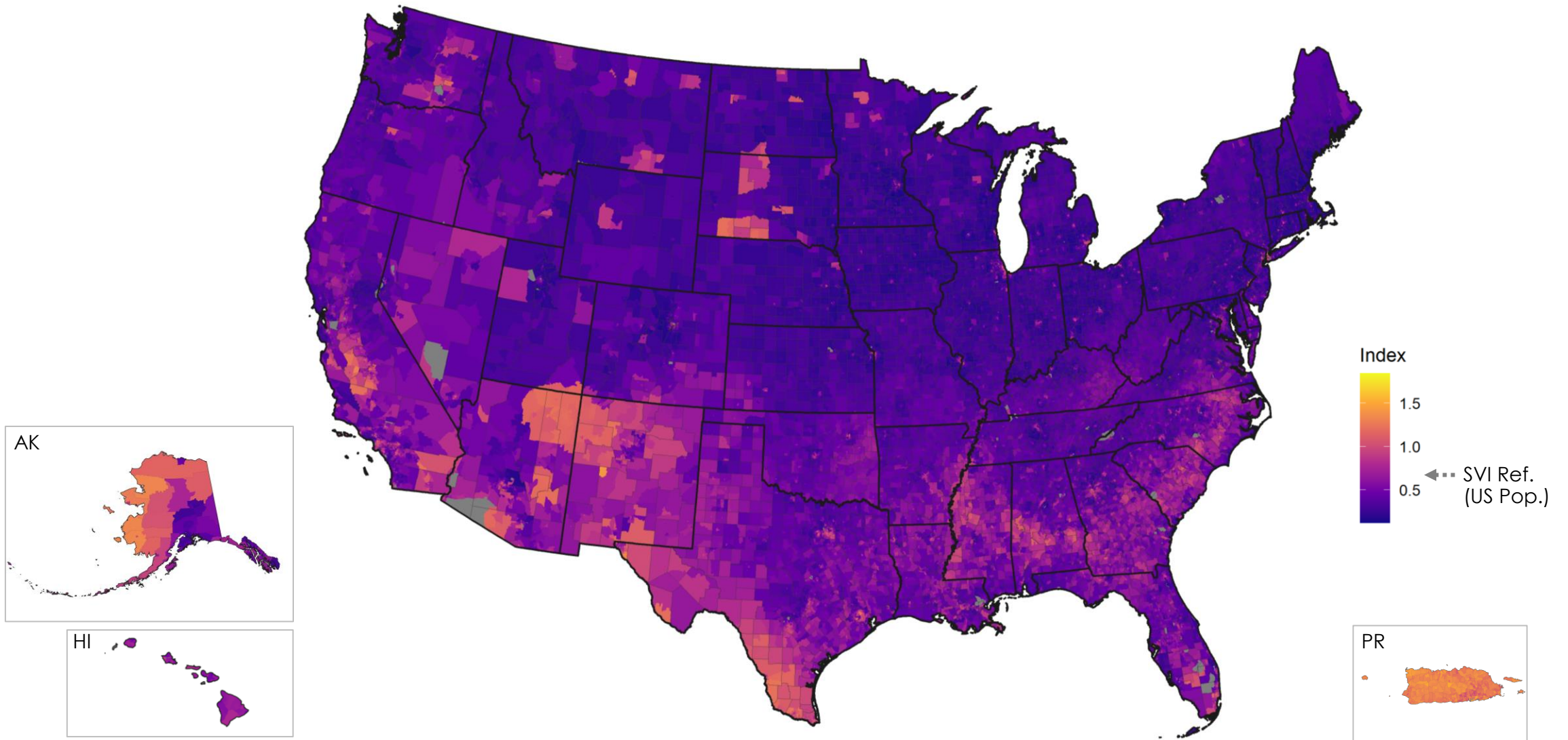


Computing the Social Vulnerability Index (SVI)

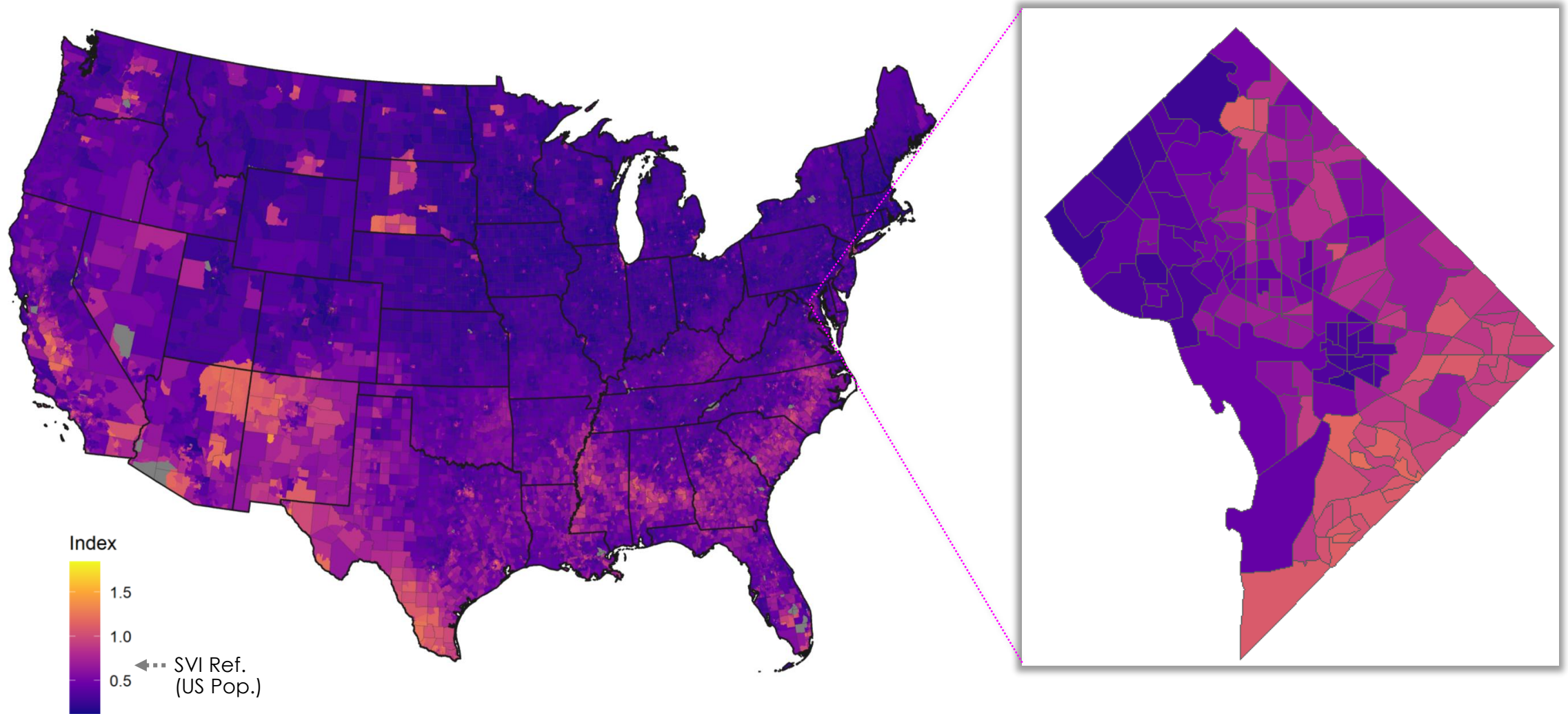


SVI Computation on UrbanPop synthetic populations for 3 census tracts in New York City.

IOSVI 2019 for the United States



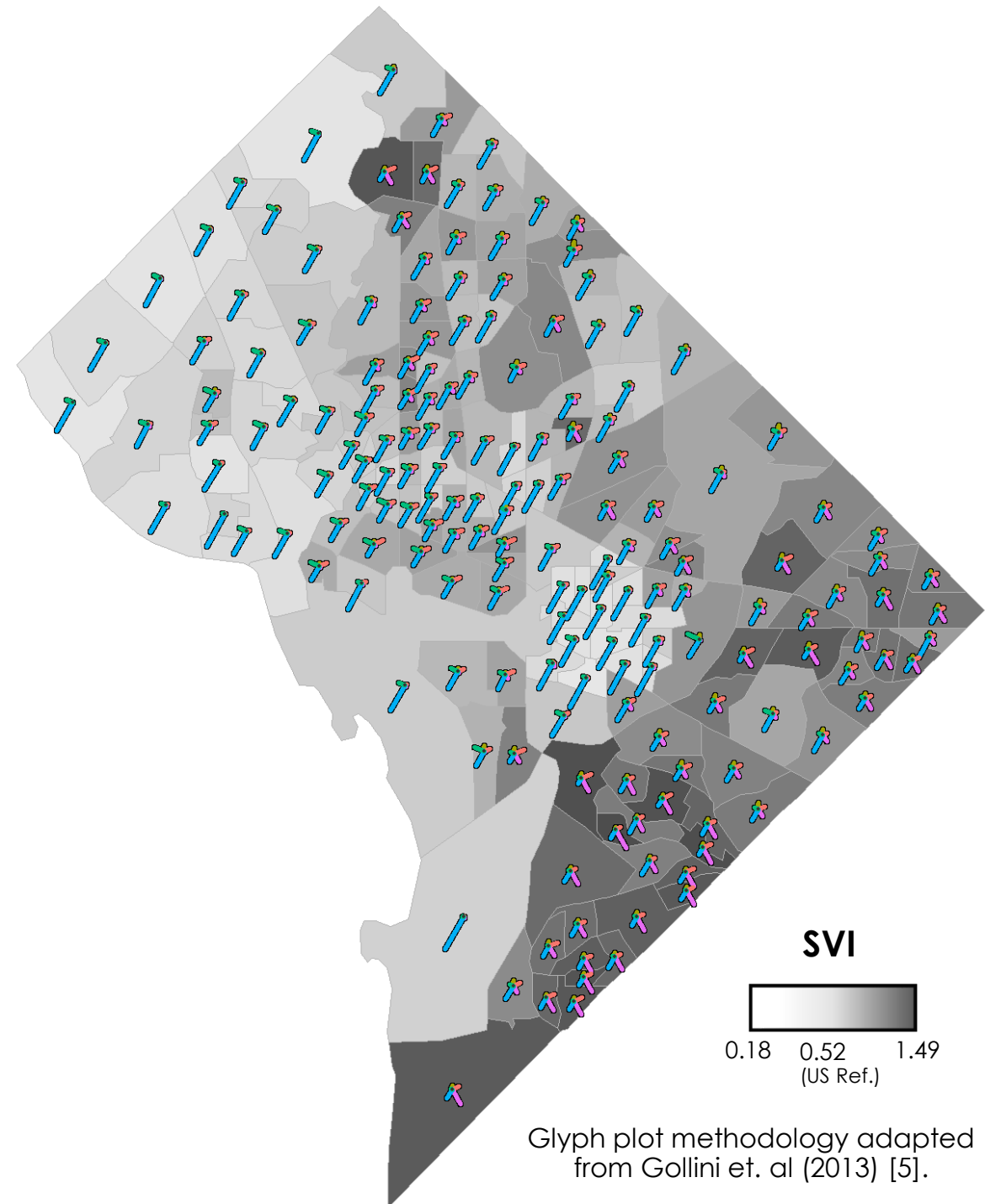
IOSVI 2019 in the District of Columbia

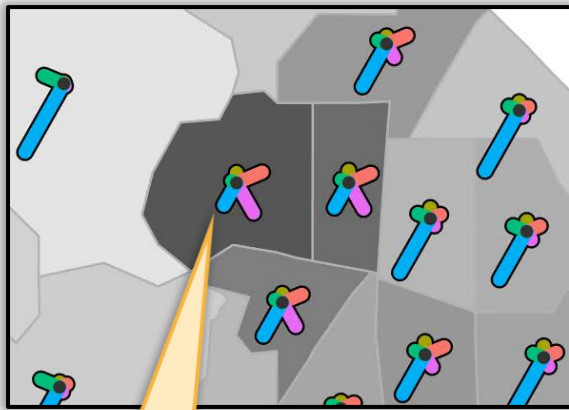


IOSVI and Geodemographics

DC IVI Themes

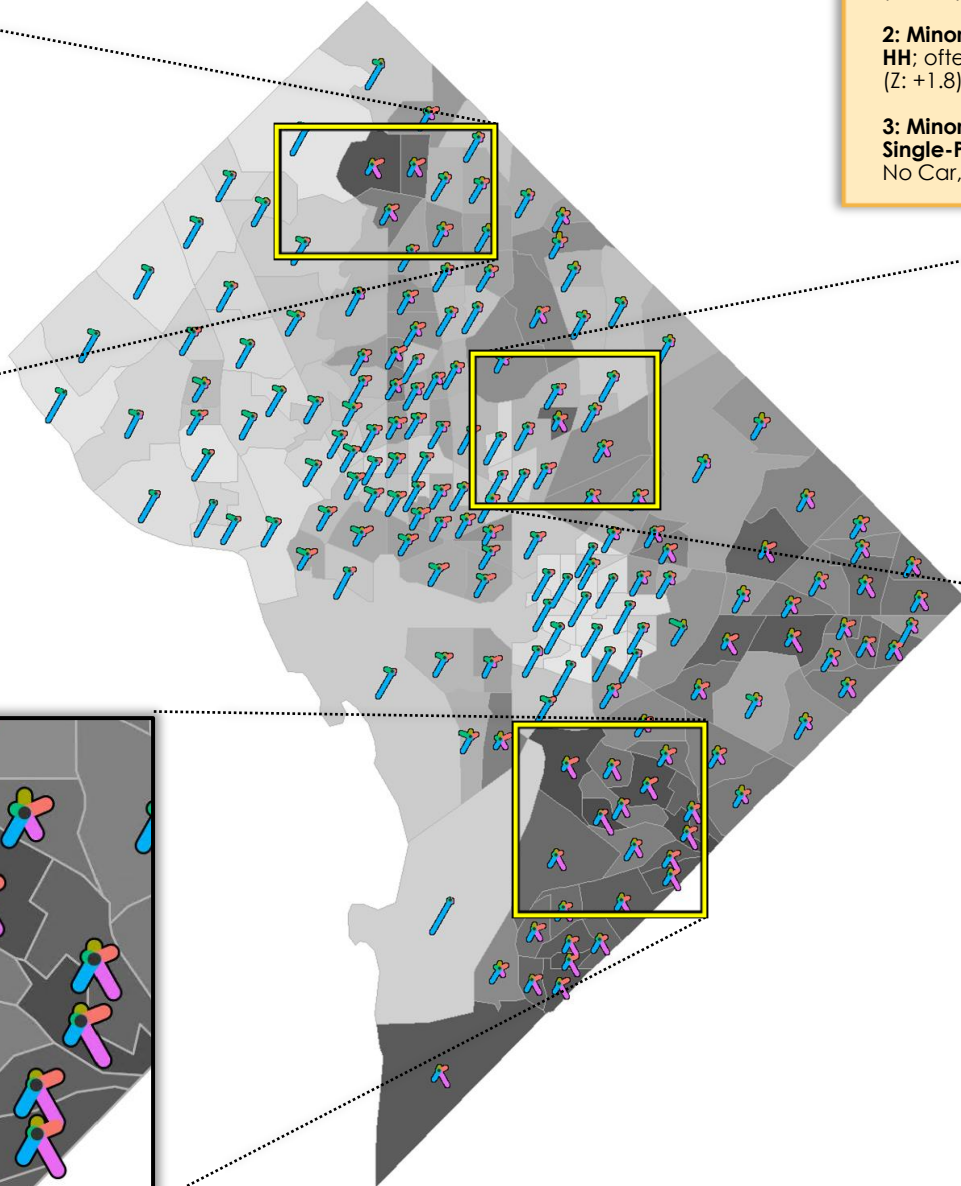
1	Outgroup/Few Indicators [Age Under 18 <-> Group Quarters]
2	Group Quarters/Age 65+
3	Disability [Age 65+ <-> No HS Diploma]
4	No Car/Minority/Density/Unemployed/LEP [No HS Diploma <-> Poverty]
5	Single-Parent HH/Crowding [Poverty <-> Age Under 18]





1: Limited English; usually Minority; often MFR. (Z: +3.5)

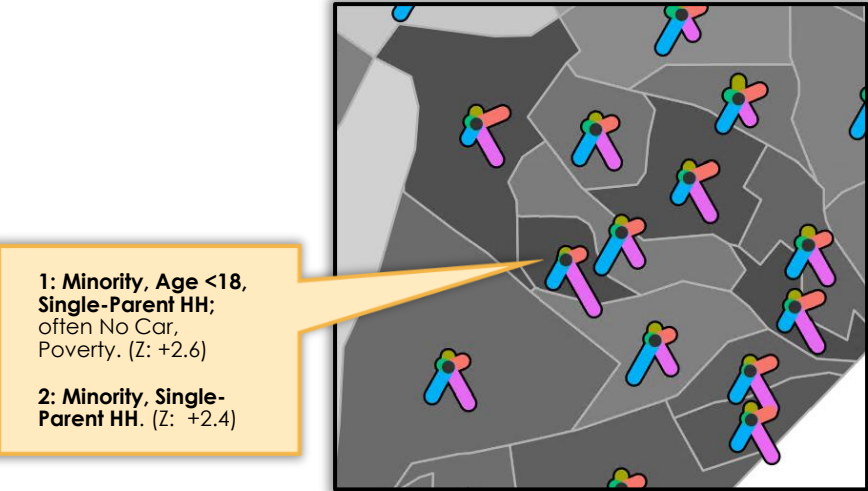
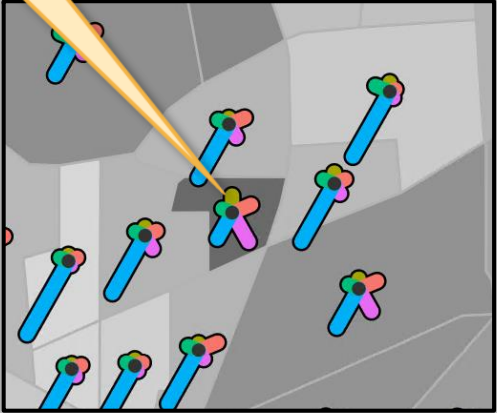
2: Minority, Crowding; often MFR (Z: +1.9)



1: Minority, Age 65+, MFR. (Z: +6.2)

2: Minority, Single-Parent HH; often No Car, MFR. (Z: +1.8)

3: Minority, Age < 18, Single-Parent HH; often No Car, MFR. (Z: +1.6)



1: Minority, Age < 18, Single-Parent HH; often No Car, Poverty. (Z: +2.6)

2: Minority, Single-Parent HH. (Z: +2.4)

DC IVI Themes

1	Outgroup/Few Indicators [Age Under 18 <-> Group Quarters]
2	Group Quarters/Age 65+
3	Disability [Age 65+ <-> No HS Diploma]
4	No Car/Minority/Density/Unemployed/LEP [No HS Diploma <-> Poverty]
5	Single-Parent HH/Crowding [Poverty <-> Age Under 18]

SVI



0.18 0.52 1.49
(US Ref.)

Glyph plot methodology adapted from Gollini et. al (2013) [5].

IOSVI and DC-Area Social, Environmental Determinants of Health

Social		
Variable	Pearson ρ	Significance
Food Insecurity Rate 2015 ^{A,B}	0.852	p < 0.001
Food Distribution Need 2015 ^{A,B}	0.74	p < 0.001
Eviction Rate 2016 ^C	0.711	p < 0.001
Eviction Filing Rate 2016 ^C	0.629	p < 0.001

Environmental		
Variable	Pearson ρ	Significance
Canopy Cover 2015 (%) ^{A,C}	-0.06	NS
Green Space 2015 (%) ^{A,C}	0.15	p < 0.05
Impervious Cover 2015 (%) ^{A,C}	-0.16	p < 0.05

Data Sources

- **A:** DC Open Data
- **B:** Capital Area Food Bank
- **C:** Eviction Lab [6]
- **D:** District Dept. of Transportation Urban Forestry Division

What's Next?

- **Customizable index creation:** beyond CDC SVI indicators
- **Neighborhood characterization toolkit**
- **Validation** on nationwide social, environmental determinants of health; regional recovery from large-scale hazards

Thank You!

Contact tuccillojv@ornl.gov

References

1. Adger, W. N. (2006). Vulnerability. *Global environmental change*, 16(3), 268-281.
2. Smit, B., & Wandel, J. (2006). Adaptation, adaptive capacity and vulnerability. *Global environmental change*, 16(3), 282-292.
3. Cutter, S. L., Boruff, B. J., & Shirley, W. L. (2003). Social Vulnerability to Environmental Hazards. *Social Science Quarterly*, 84(2).
4. Flanagan, B. E., Gregory, E. W., Hallisey, E. J., Heitgerd, J. L., & Lewis, B. (2011). A social vulnerability index for disaster management. *Journal of homeland security and emergency management*, 8(1).
5. Gollini, I., Lu, B., Charlton, M., Brunson, C., & Harris, P. (2013). GWmodel: an R package for exploring spatial heterogeneity using geographically weighted models. arXiv preprint arXiv:1306.0413.
6. Peter Hepburn, Renee Louis, and Matthew Desmond. Eviction Tracking System: Version 1.0. Princeton: Princeton University, 2020.