Spatial Analysis on Environmental Justice in Los Angeles County

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SOUTHERN CALIFORNIA ASSOCIATION of GOVERNMENTS

Why Environmental Justice (EJ)

- Integrate the principles of Environmental Justice into SCAG's transportation plan

  - Low-income and minority communities should have ample opportunity to participate in transportation decisions
  - They should receive an equitable distribution of benefits and not a disproportionate share of burdens

Legal Background of EJ

- Title VI
  - Avoid, minimize, or mitigate adverse effects, on sensitive population
  - Ensure the participation by all in the transportation decision-making process
- SB 535 (Greenhouse Gas-Reduction Investments to Benefit Disadvantaged Communities)
  - Requires Cal/EPA to identify disadvantaged communities
  - Requires that at least 10 percent of the available moneys must be directly allocated in disadvantaged communities

Research Goals

- Identification of areas with Environmental Justice (EJ) concerns in Los Angeles county
  - Focusing on air quality
  - Unit of Analysis = Census Tract
- Analysis on transportation and land use contributing factors to the EJ areas

Identification of EJ Areas

- Quantifying and aggregating 4 aspects of EJ by Census Tract

	Variables	Source of Data
Air quality	Particulate Matter 2.5 (PM 2.5) Diesel Particulate Matter (DPM) Ozone, CO_1, CO_2, Nitrogen	CalEnviroScreen (PM 2.5, DPM, & Ozone) SCAG (PM 2.5, CO_1, CO_2, & Nitrogen)
Sensitive population	Minority Population, Persons below Poverty Senior Population, Child Population, Renters Educational Attainment Unemployed Population Population without an Automobile	U.S. Census (2013 ACS 5-yr. Est.)
Public health	Low Birth Weight Asthma-related Emergency Visits Women, Infant, and Children (WIC) Vendors	CalEnviroScreen 2.0 California Department of Public Health (CDPH)
Environmental nuisance	Solid Waste Facilities, Superfund Sites Clean-Up Sites	

Air Quality Variables and Score

PM 2.5 (EnviroScreen)

Diesel PM

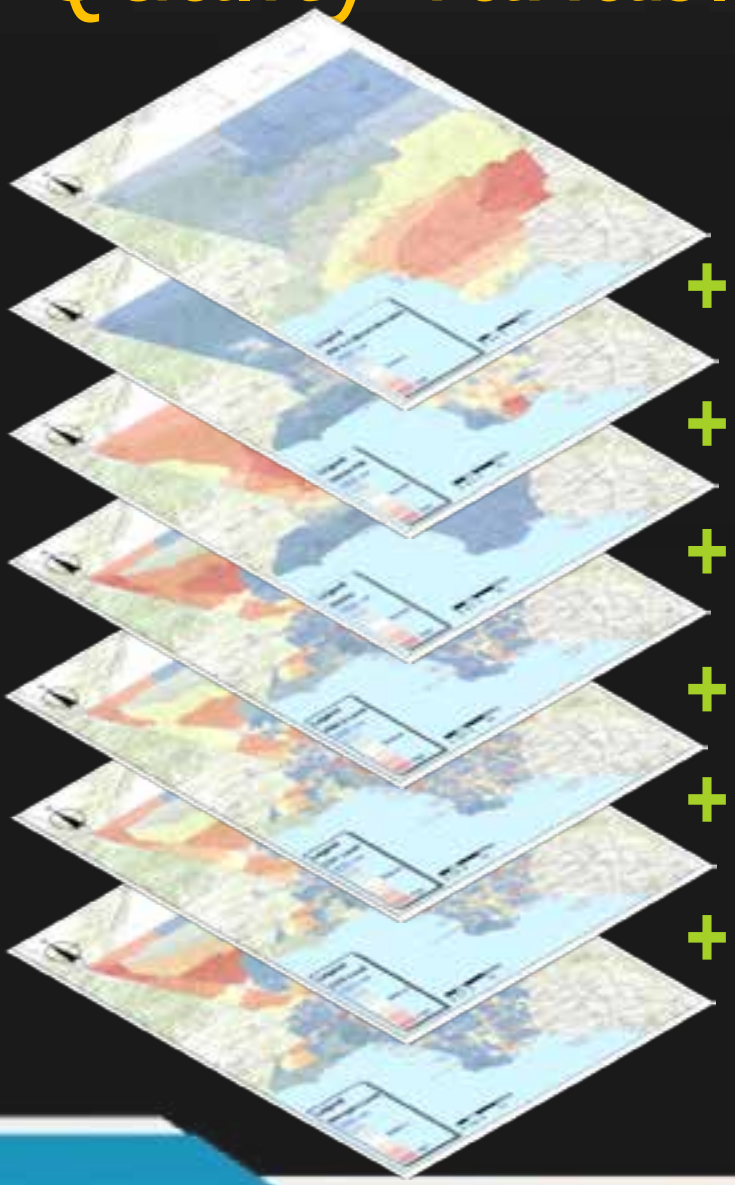
Ozone

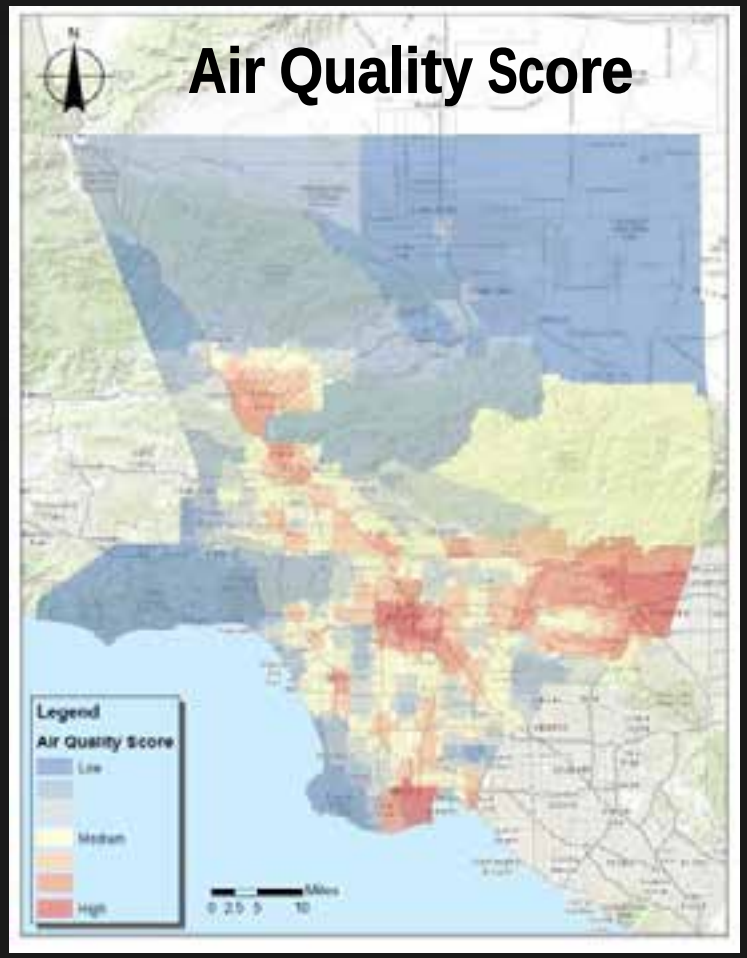
PM 2.5 (SCAG)

CO_1

CO_2

Nitrogen





Sensitive Population Variables and Score

Minority

Poverty

Senior

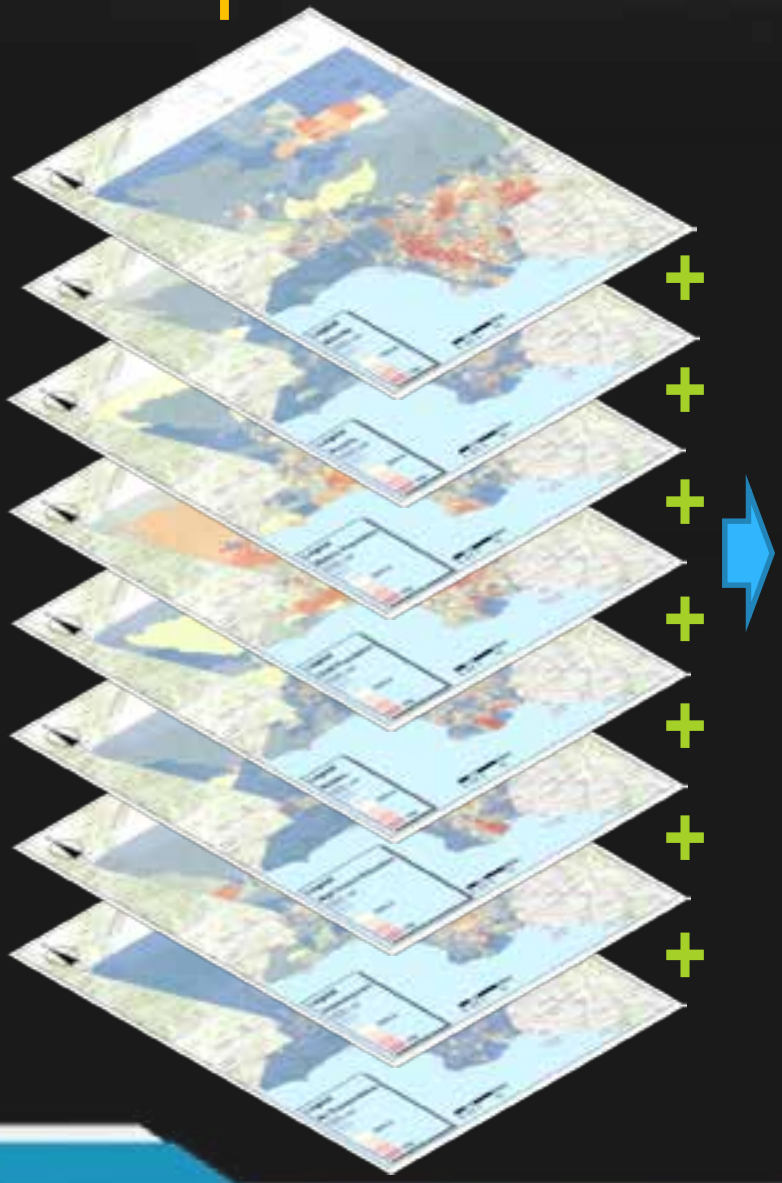
Child

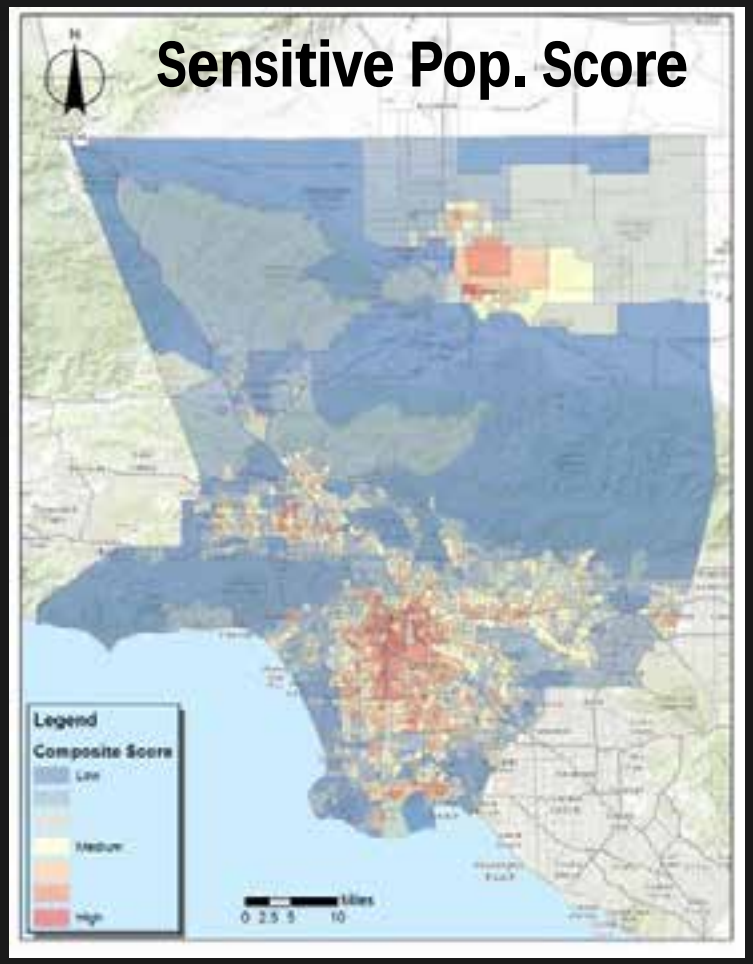
Renters

Education

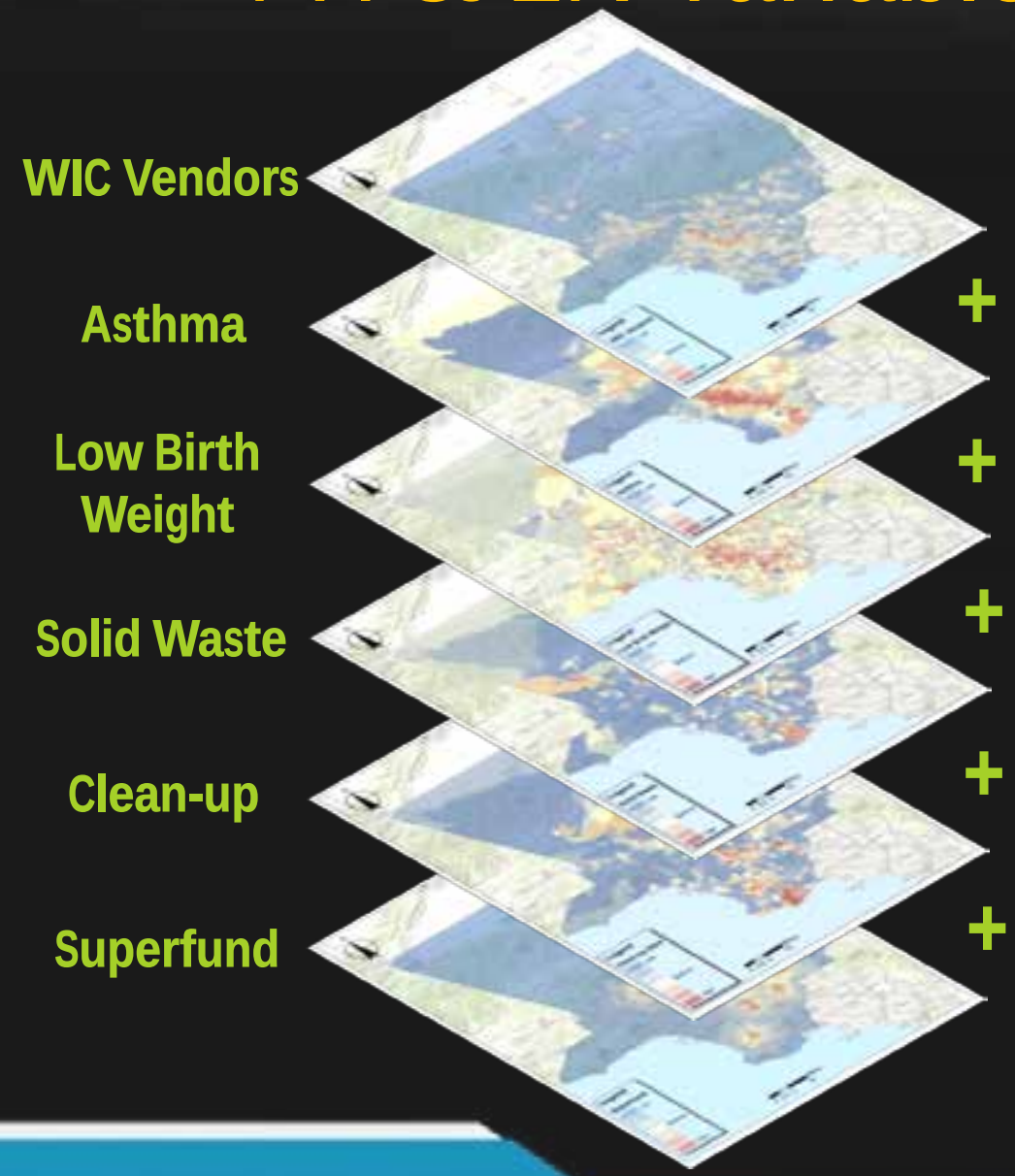
Unemployment

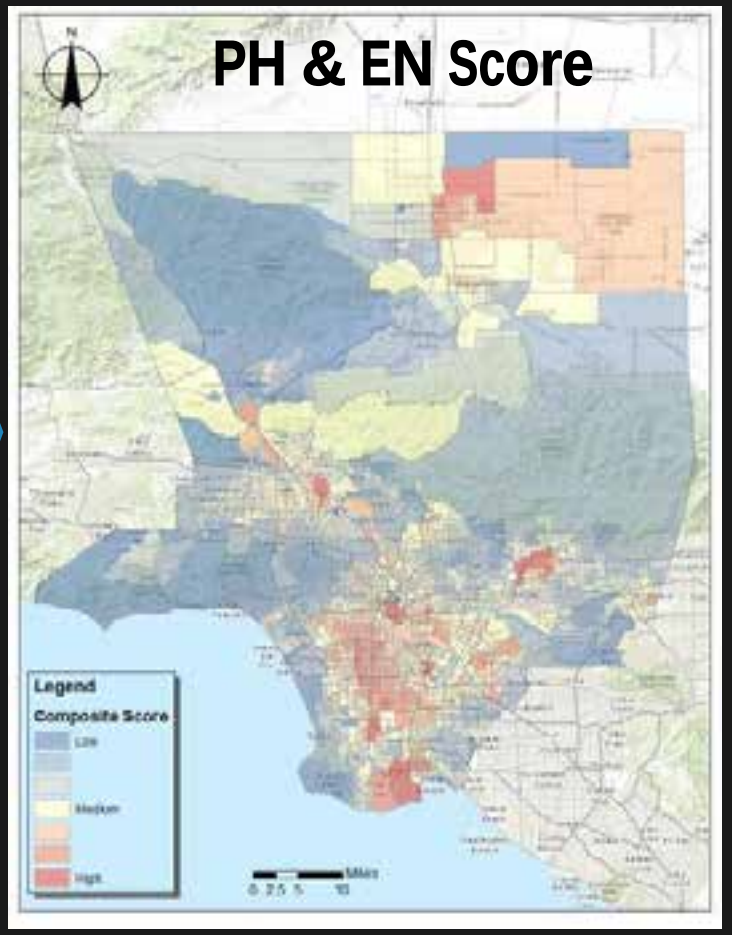
No Automobile





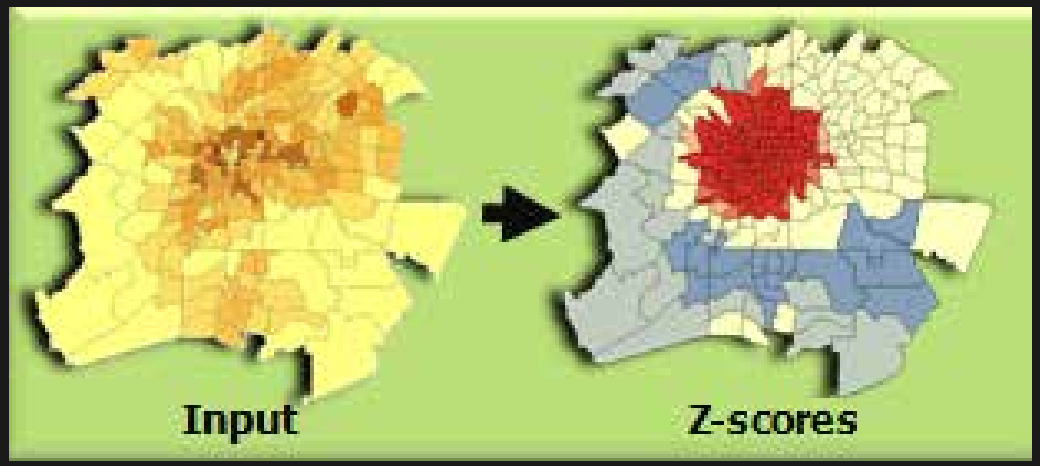
PH & EN Variables and Score





Identification of EJ Areas

- Identifying the areas with the concentration of high score by conducting spatial cluster analysis (Getis-Ord Gi*)



Identification of EJ Areas

Air quality Score

Sensitive population Score

PH & EN Score

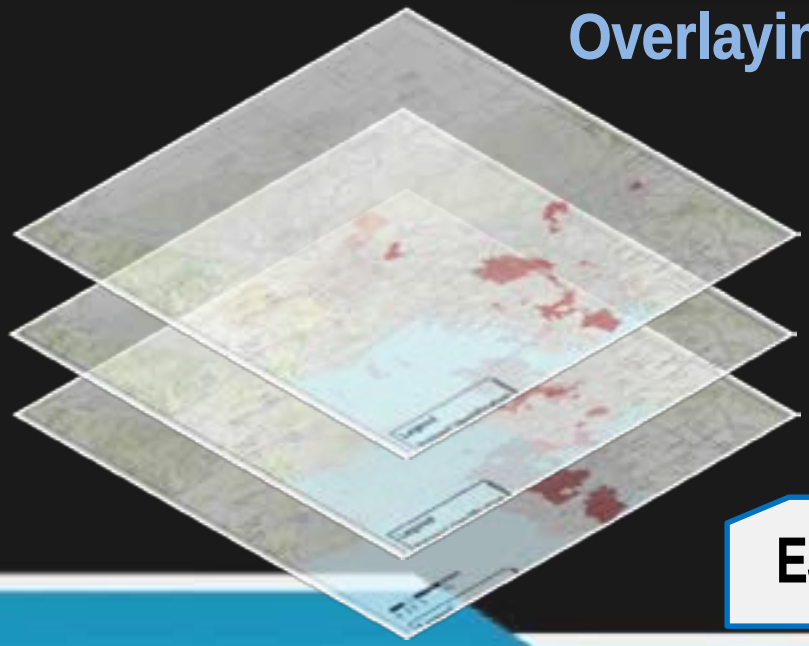
Spatial Cluster Analysis

Cluster areas

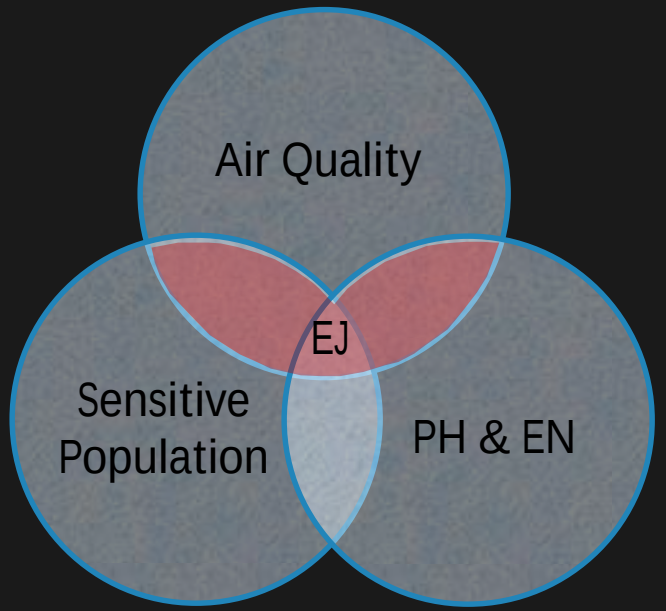
Cluster areas

Cluster areas

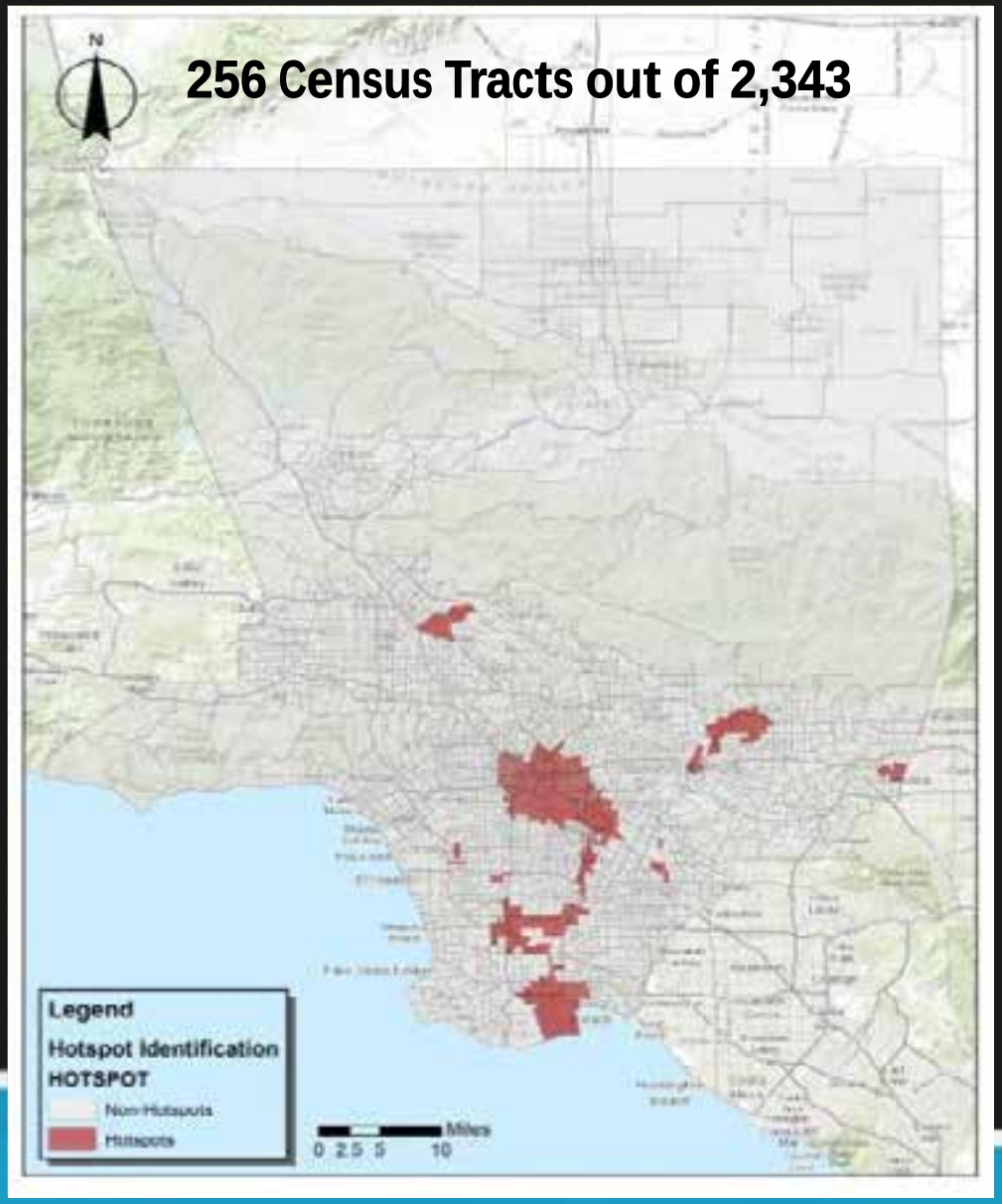
Overlaying



EJ areas



Map of EJ Areas



Analysis of Contributing Factors

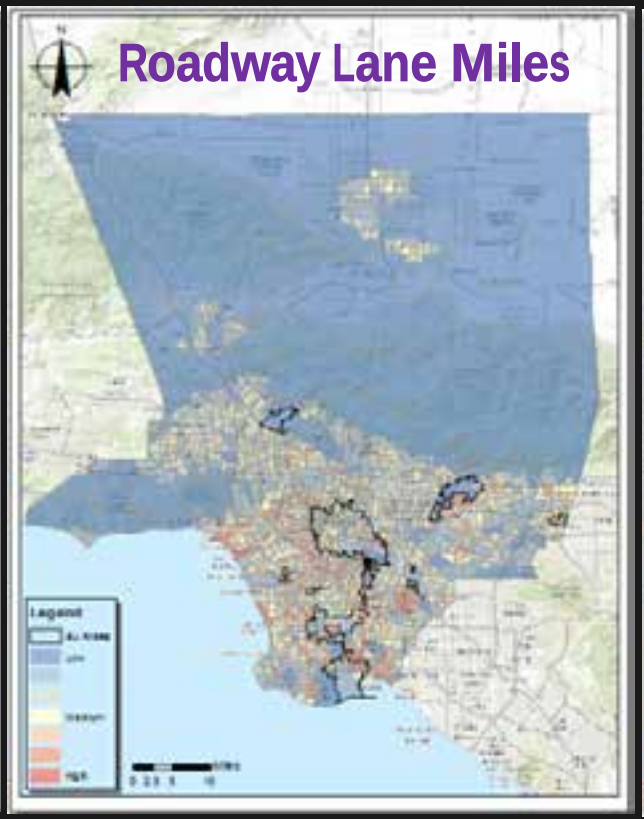
- Analysis of factors that potentially associate with EJ areas in these physical aspects
  - Transportation
  - Land Use
- Quantifying a variety of variables by Census Tract using GIS analysis
- Identifying the potential contributing factors by conducting statistical analysis
  - T-Test
  - Logistic Regression

Analysis of Transportation Factors

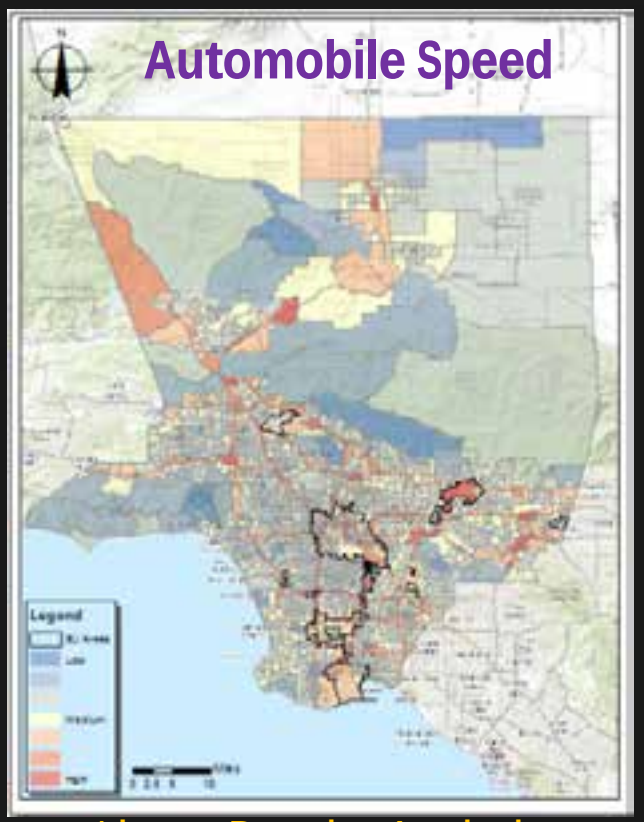
- Variables analyzed
  - Highway/Roadway
    - Roadway lane mile
    - Highway land mile
    - Automobile speed
  - Public Transit
    - TOD stations (Y/N)
    - Transit stations (Y/N)
    - Bus stop density
  - Active Transportation
    - Bicycle facility density
    - Bicycle collision density
    - Intersection density
  - Railroad
    - Freight rail distance
- Data sources
  - SCAG
  - NTAD
  - LA Metro

Highway/Roadway Factors

Linear Density Analysis



Linear Density Analysis

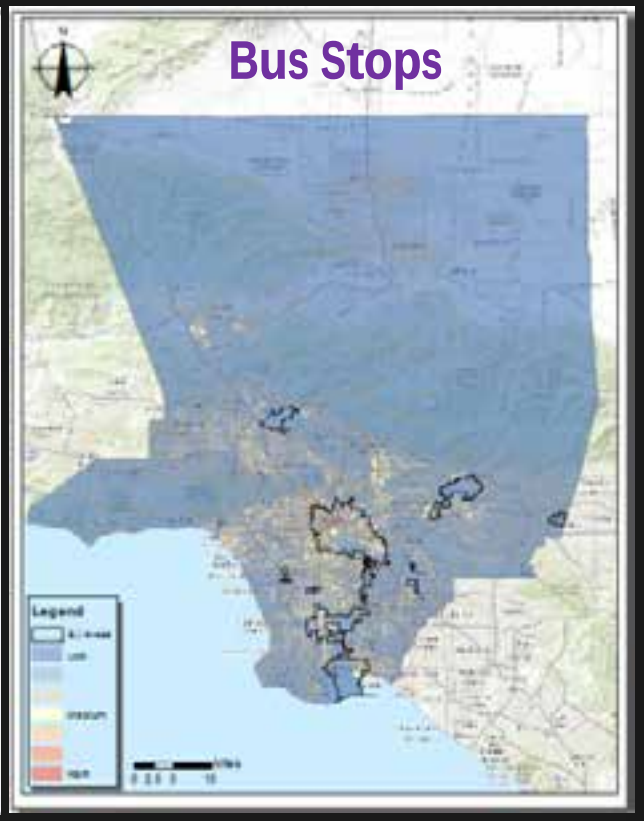


Linear Density Analysis

Public Transit Factors

Buffer Analysis

Buffer Analysis



Point Density Analysis

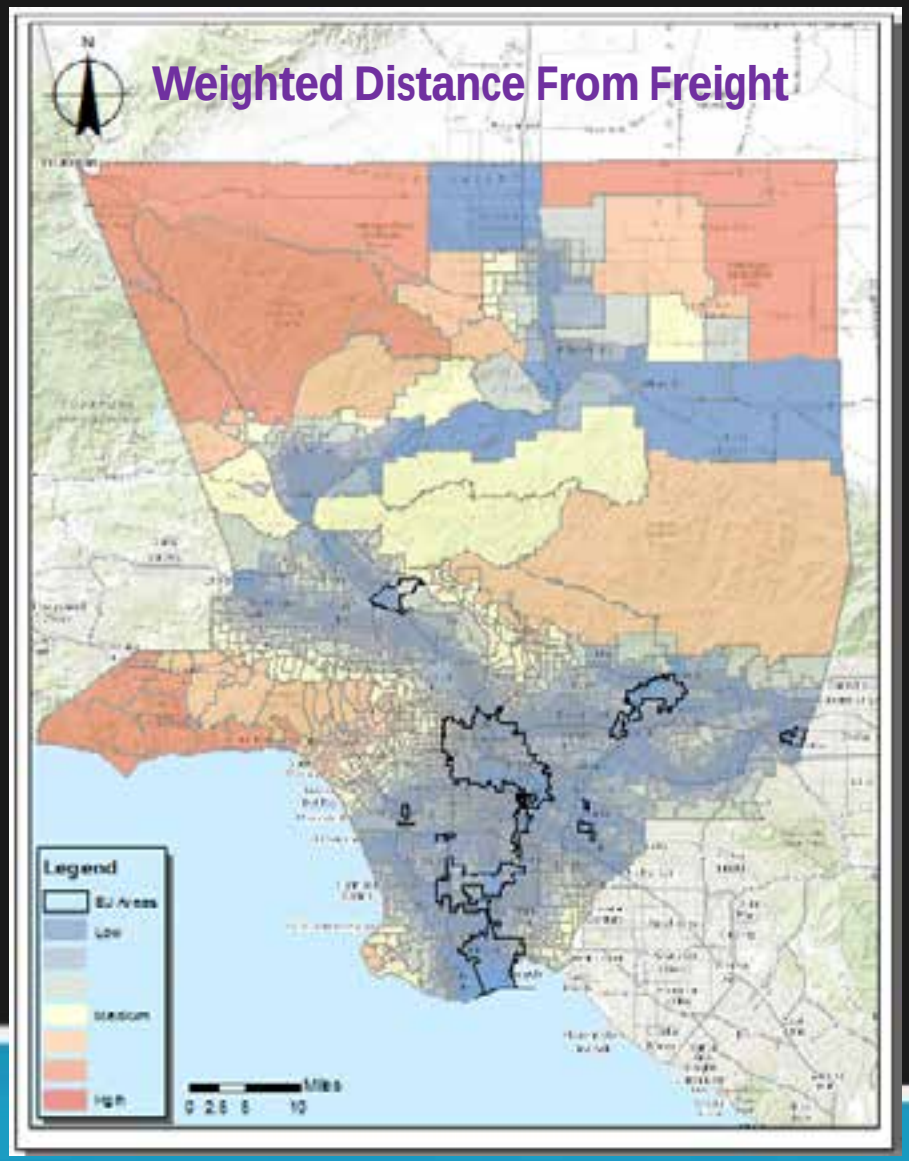
Active Transportation Factors

Point Density Analysis

Linear Density Analysis

Point Density Analysis

Railway Factor



Weighted Distance Analysis

T-Test and Logistic Regression Output

Methods	**T-Test**			**Logit**		
Variables	EJ Areas (Mean)	Non EJ Areas (Mean)	T-Stat.	Coef.	S.E.	Exp(B)
Intercept	-	-	-	-5.840	1.257	0.003
TOD (Y=1, N =0)	-	-	-	0.369	0.403	1.446
Transit (Y=1, N =0)	-	-	-	***-1.054	0.180	0.348
Freight Rail	6584.473	11652.534	***-11.268	***-0.001	0.000	1.000
Bus Stop	812.763	246.736	***9.031	***0.002	0.000	1.002
Bike Route	1.620	1.390	1.621	-0.056	0.045	0.946
Bike Crash	0.218	0.081	***1.969	***3.908	0.718	49.822
Highway	0.021	0.010	***1.968	-5.129	6.451	0.006
Roadway	0.086	0.079	***1.967	-2.657	3.800	0.070
Speed Limit	36.489	33.681	***1.968	***0.096	0.032	1.100
Intersection	1.59	1.081	***1.968	-	-	-
				Cox & Snell R^2		0.398

The variable, Intersection, was excluded from the logit regression due to its' multicollinearity

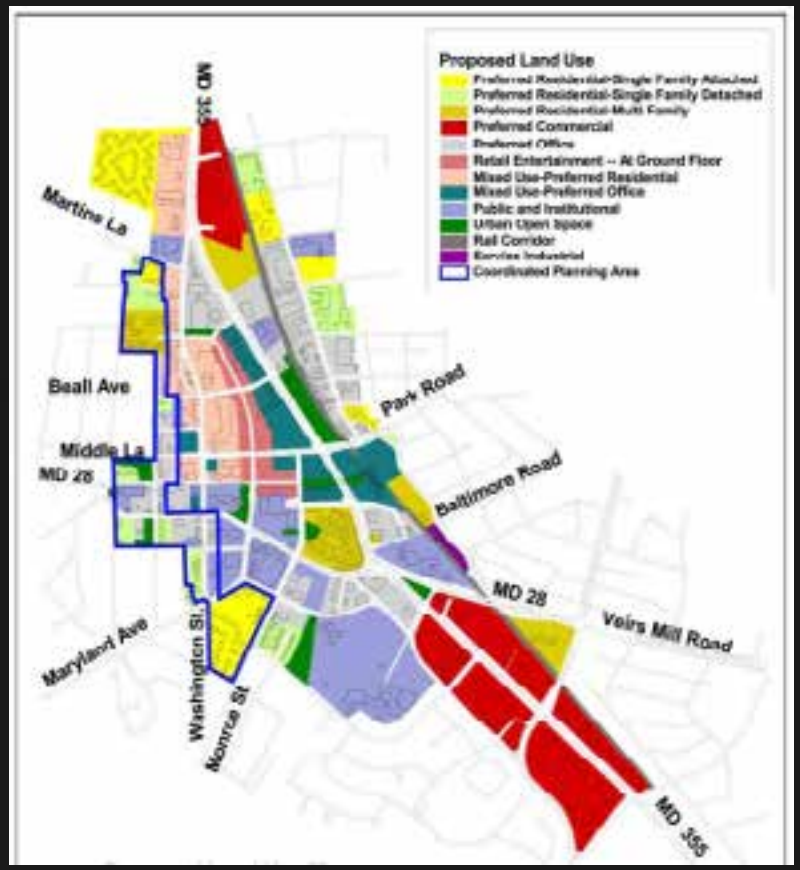
*, **, *** Correlations are significant at the 0.10, 0.05, and 0.01 levels, respectively (2-tailed)

Summary of Findings

- Logistic regression shows notable differences between bus stops and distance to freight rail.
- TOD's have no relationship with EJ areas.
- Surprisingly, there is no correlation of the EJ areas with highway and roadway features

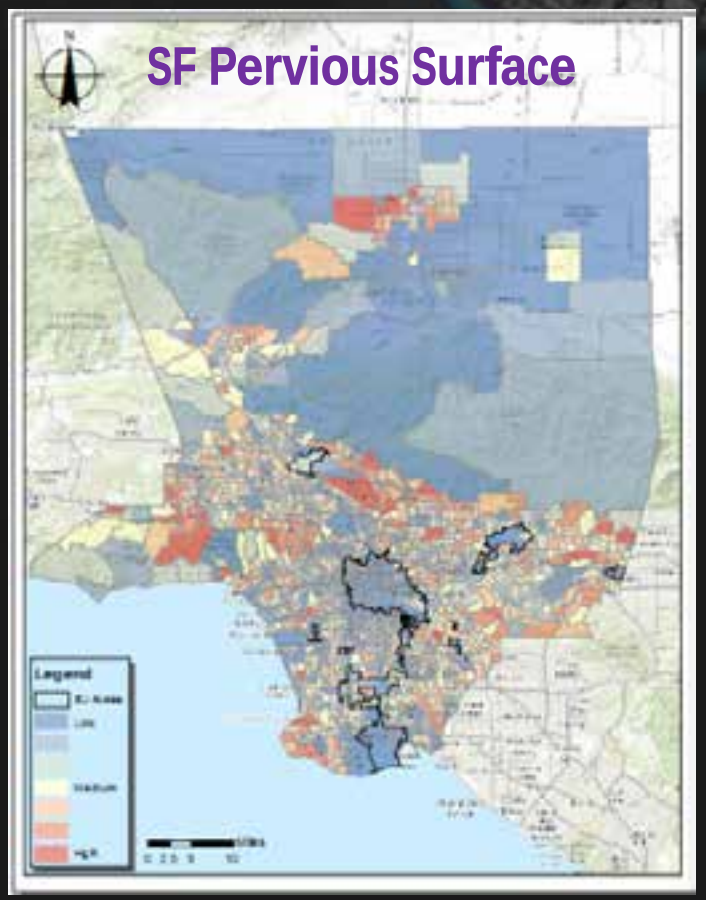
Analysis of Land Use Factors

- Variables analyzed
  - Residential
    - Multi-family residential
    - Single family pervious surface
  - Non-residential
    - Industrial
    - Retail
    - Office
    - Open space
- Data sources
  - SCAG
  - LA County GIS Portal

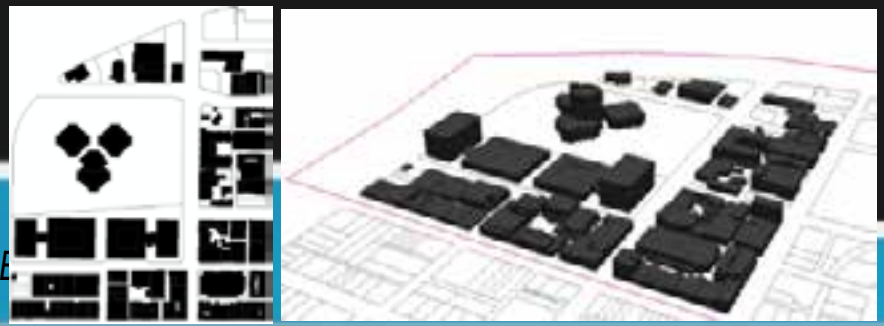


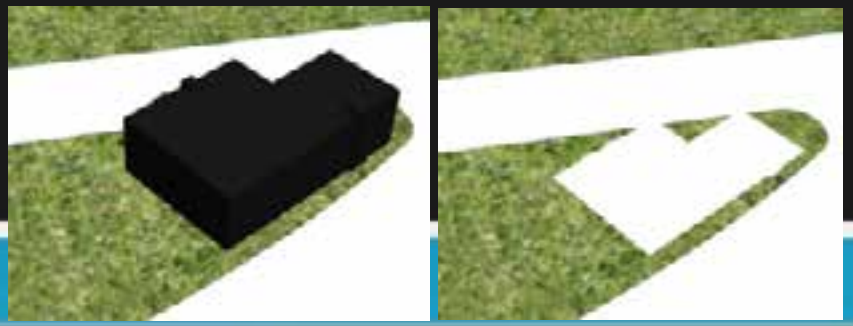
Residential Factors

Building Density Analysis



Property Area – Building Footprint

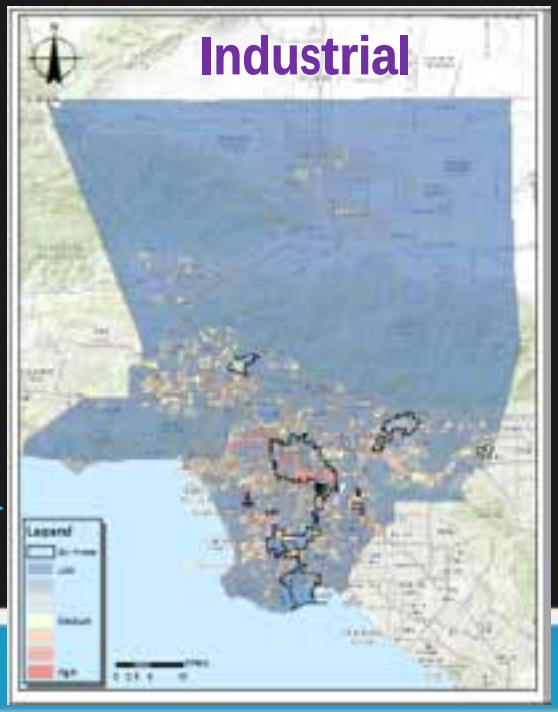


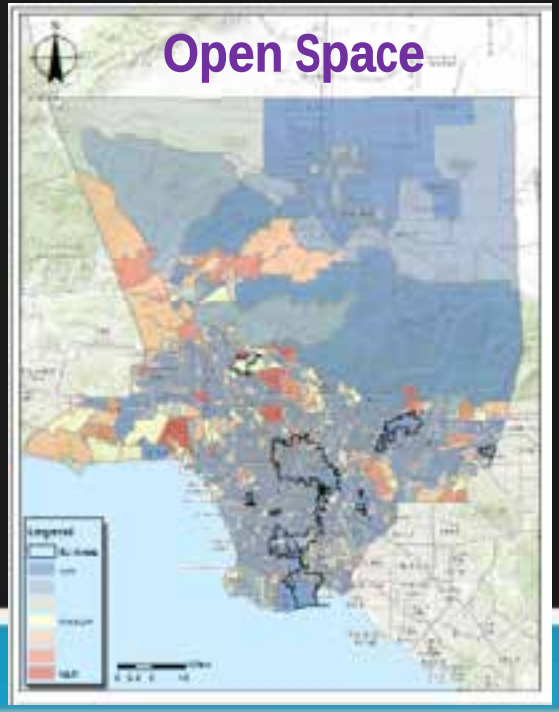


Non-Residential Factors

Building Density Analysis →

Property Density Analysis →





T-test and Logistic Regression Outputs

Method	T-test			Logit		
Variables	EJ Areas (Mean)	Non EJ Areas (Mean)	T-Stat.	Coef.	S.E.	Exp(B)
Intercept				-0.819	0.121	0.441
Industrial	0.114	0.101	1.436	**-1.090	0.545	0.336
Multi-Family	1.587	1.362	0.392	**-0.722	0.328	0.486
Office	0.196	0.054	***2.781	0.297	0.185	1.340
Open Space	0.034	0.054	***-2.747	-0.798	0.654	0.450
Pervious Surface	12.037	63.699	***-27.178	***-0.040	0.003	0.961
Retail	0.107	0.042	***5.428	***1.763	0.491	5.828
				Cox & Snell R^2		0.138

*, **, *** Correlations are significant at the 0.10, 0.05, and 0.01 levels, respectively (2-tailed)

Summary of Findings

- The relationship between EJ factors and Land-use analysis is not as transparent as anticipated.
  - Industrial land-use is not found to be significant.
  - Pervious surface and retail show consistent results among statistical models.

Conclusion & Discussion

- The contribution of the transportation factors to the EJ areas is identified, while that of the land use remains unanswered.
- Public transit, particularly bus, serves the EJ areas appropriately, but it may cause public health and safety concerns.
- The unclear relationship between land use and EJ may caused by the spatial segregation between residential land use and non-residential land use.
- Future studies should properly address issues with the unit of analysis (Census Tract)