Spatial nonstationarity and property crime in Vancouver, Canada

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Spatial criminology literature

- Crime varies across space

  - This is "old news" going back to the early 1800s

- Many social constructs also vary across space

  - This is also old news

- Social disorganization and routine activity theory

  - Used to explain the causality between variations in crime and variations in social constructs

Spatial criminology in practice

- Hot/cold spots

- (Spatial) regression analysis

- But what is the output in (spatial) regression analysis?

- What does it assume?

Assumption for regression parameters

- Parameters are "global"

- One parameter to represent entire study area (often a city)

- Is this realistic?

An alternative: local regression modeling

- Geographically weighted regression

- A regression for every spatial location

- $y_i = \beta_0(u_i, v_i) + \sum_k \beta_k(u_i, v_i)x_{ik} + \varepsilon_i$

Previous research using GWR in crime analysis

- Not all places have statistically significant results
    - Often less than half of places are responsible for global results

- Magnitude of parameters often varying significantly
    - Not unusual for parameters to change signs

- Both these effects have significant theoretical and policy implications
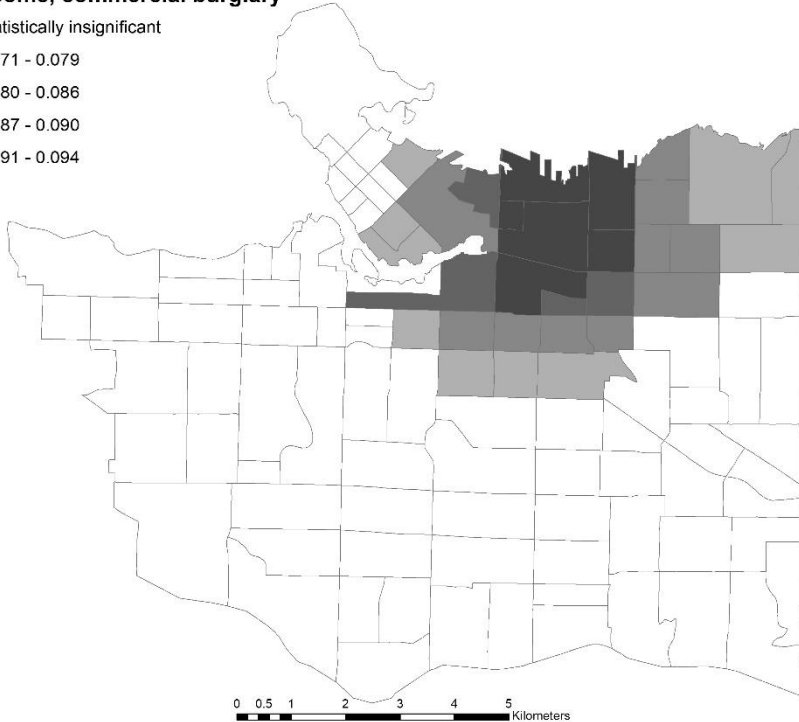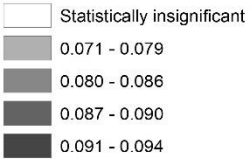
Current research

- GWR using Vancouver census tracts, 2016

- Multiple measures of property crime
  - Residential burglary, commercial burglary, theft of vehicle, theft from vehicle, other theft, mischief, aggregate property crime

- Theoretical framework: social disorganization theory and routine activity theory

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Geographically weighted regression results, results summary

	Commercial burglary		Residential burglary		Mischief		Theft from vehicle		Theft of vehicle		Theft		Property	
	Global	Local	Global	Local	Global	Local	Global	Local	Global	Local	Global	Local	Global	Local
Unemployment rate				-										
Population change, %	+	+	+	+	+	+	+	+	+	+	+		+	+
Rented, %			-	-	-	-		-					-	-
Major repairs, %	-	-	-	-	-	-	-	-	-		-	-	-	-
Old houses, %			+	+										
Move, 1 year, %														
Post secondary, %														
Low income, %		+	+	+	+	+	+	+		+			+	+
Government assistance, %	-	-	-	-	-	-	-	-	-	-	-		-	-
Average dwelling value, 000s					-	-	-	-	-	-	-	-	-	-
Average rent, 00s			-	-										
Median family income, 000s											-	-		
Aboriginal, %			+	+					+					
Immigrants, %				+				-						
Recent immigrants, %					+	+						+	+	+
Visible minorities, %														
Ethnic heterogeneity		+				+								

GWR results, commercial burglary

Low income, commercial burglary

- ☐ Statistically insignificant
- ☐ 0.071 - 0.079
- ☐ 0.080 - 0.086
- ☐ 0.087 - 0.090
- ■ 0.091 - 0.094

0 0.5 1   2   3   4   5
Kilometers

Government assistance, commercial burglary

- ■ -0.133 - -0.130
- ■ -0.129 - -0.126
- ■ -0.125 - -0.121
- ☐ -0.120 - -0.115
- ☐ Statistically insignificant

N

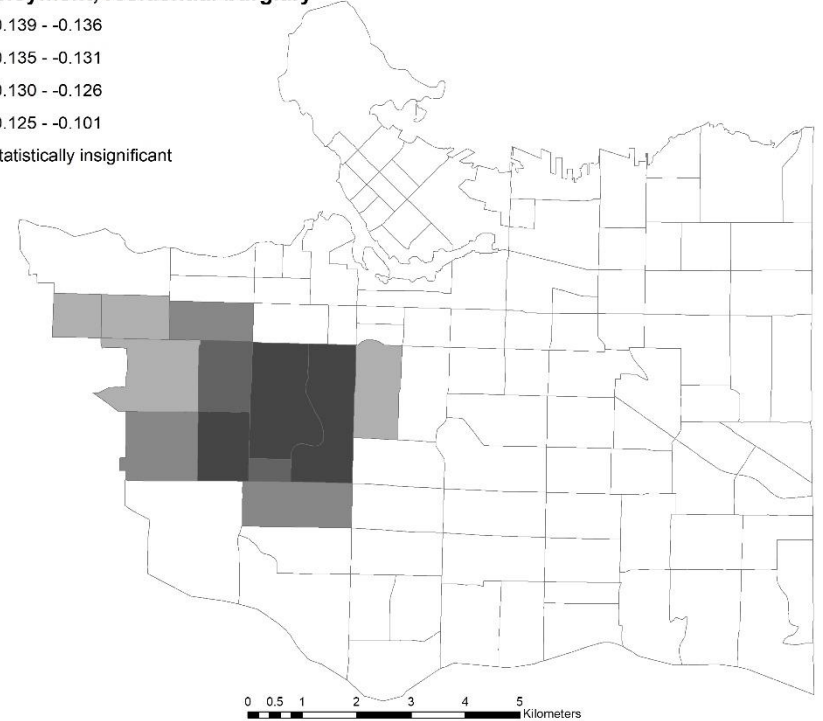0 0.5 1   2   3   4   5
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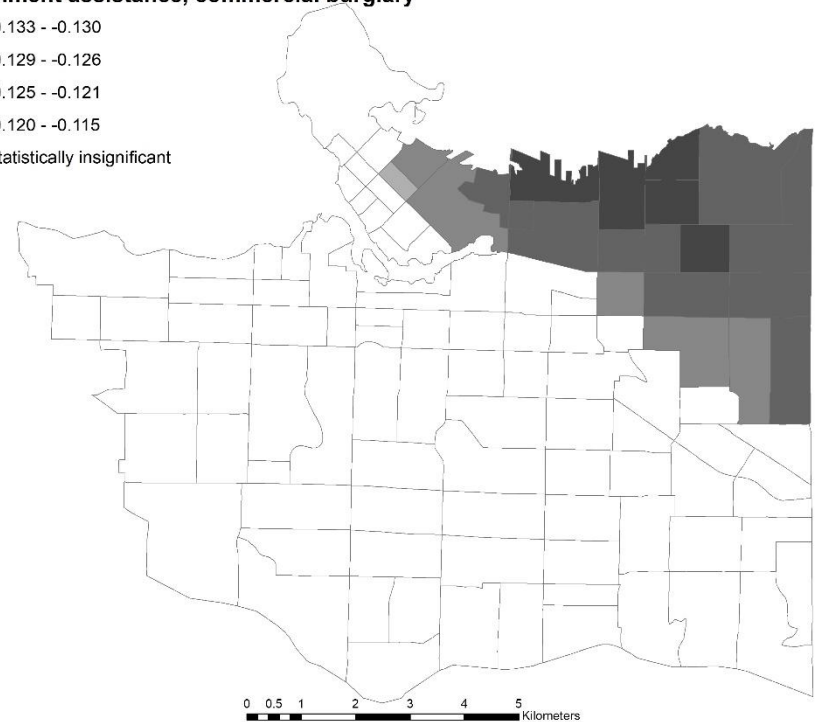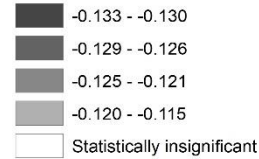
GWR results, residential burglary
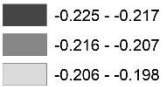
Population change, residential burglary

- Statistically insignificant
- 0.001 - 0.009
- 0.010 - 0.011
- 0.012 - 0.013
- 0.014 - 0.015
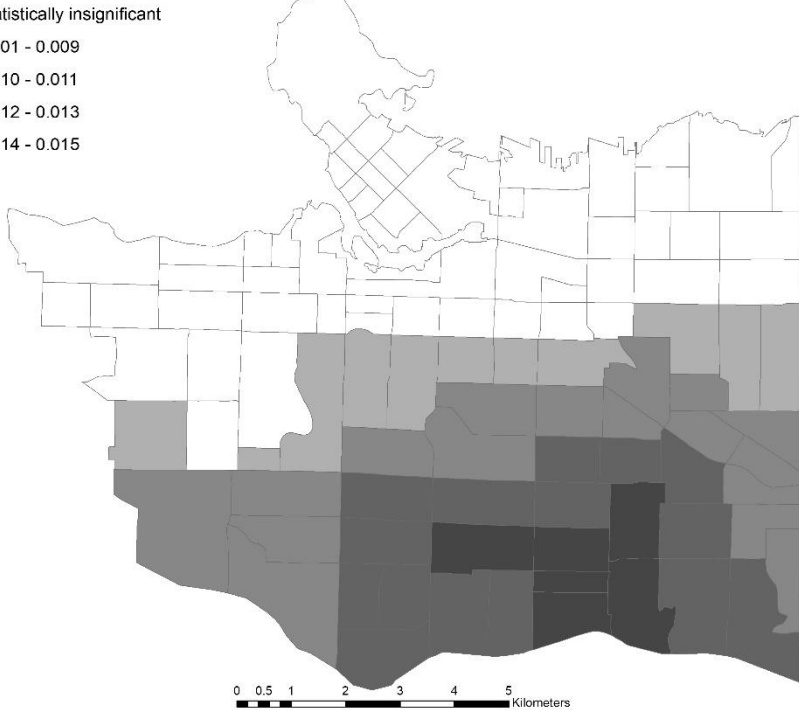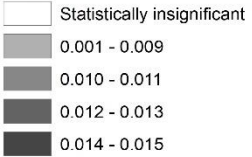
Unemployment, residential burglary

- -0.139 - -0.136
- -0.135 - -0.131
- -0.130 - -0.126
- -0.125 - -0.101
- Statistically insignificant

N

0   0.5   1   2   3   4   5
Kilometers

0   0.5   1   2   3   4   5
Kilometers
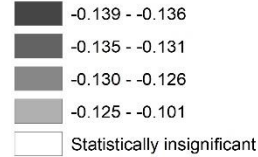
GWR results, major repairs

Major repairs, theft from vehicle

- ■ -0.225 - -0.217
- ▓ -0.216 - -0.207
- ░ -0.206 - -0.198

Major repairs, theft

- ■ -0.394 - -0.384
- ▓ -0.383 - -0.376
- ▒ -0.375 - -0.365
- ░ -0.364 - -0.349
- □ Statistically insignificant

N

0 0.5 1   2   3   4   5
Kilometers

0 0.5 1   2   3   4   5
Kilometers
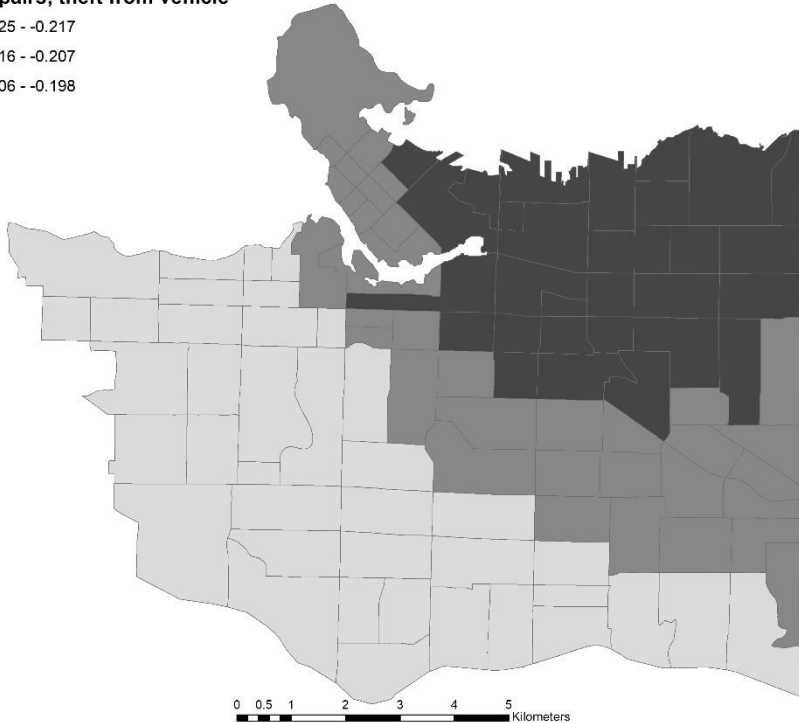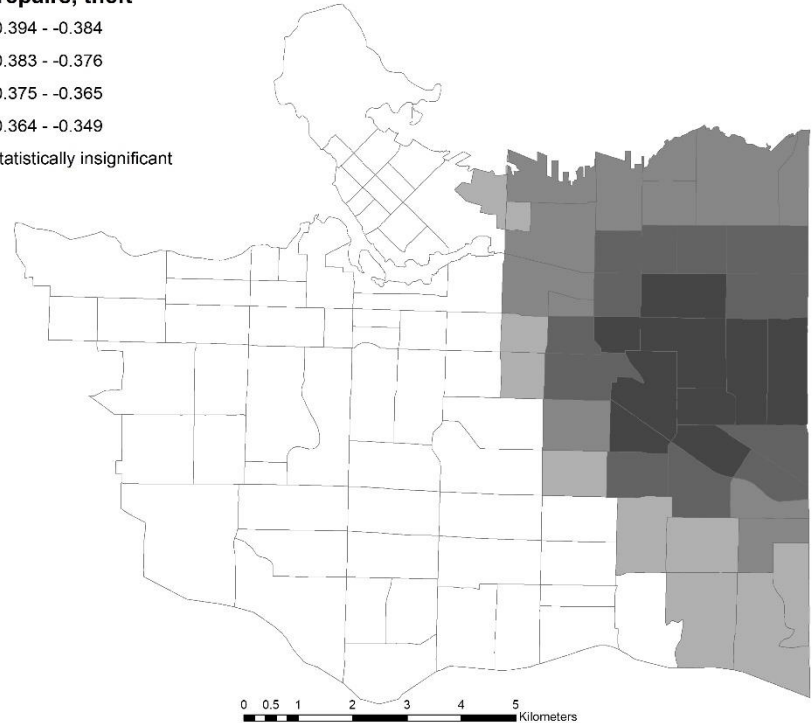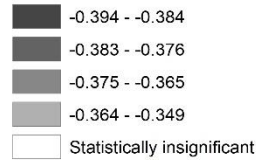
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Concluding thoughts

- There is spatial heterogeneity in these results

    - Most often, only some places driving global results

    - Sometimes, variation is of little consequence

    - No statistically significant sign switching

- Important for theoretical testing

- Critical to know for policy implementation

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Thank you!

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