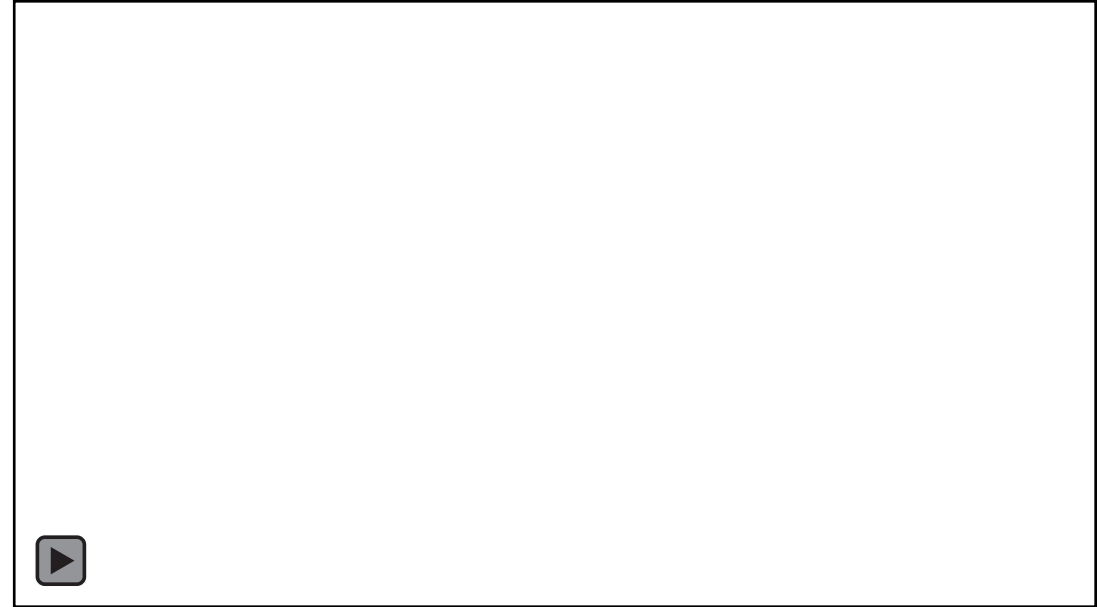


Measuring risk at places



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A little about me...



Professor, School of Criminology, Simon Fraser University

Background in economics and (human) geography

Spent the better part of the last 3 years in Gold Coast, Australia

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What we're going to go over today



This will be “old hat” for some people here



But these are important issues that should not be given a nod and forgotten



Spatial scale and its implications



Data sources for measuring risk (better)



Measures of risk

Considerations of scale

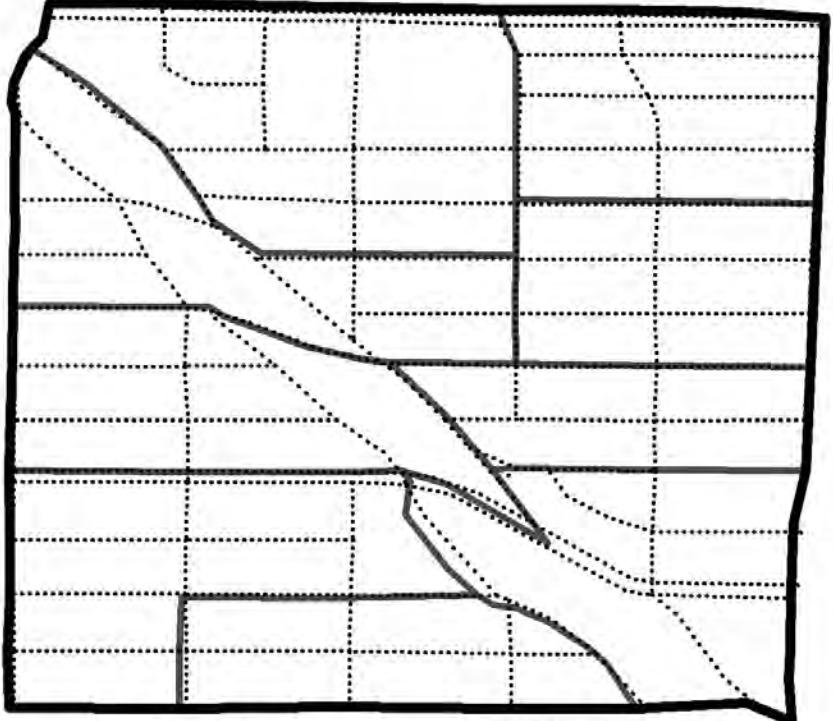
- Spatial criminology
 - Been moving to smaller and smaller units of analysis for 200 years
- Does not mean that larger units of analysis are not instructive
- Data limitations often dictate the spatial unit of analysis
 - Confidentiality, or just availability
- But scale matters a lot

Table 3 Percentage of street segments and intersections accounting for 50 % of crime

	Percentage of spatial units accounting for 50 % of crime				Percentage of spatial units that have any crime				Percentage of spatial units with any crime that account for 50 % of crime			
	1991	1996	2001	2006	1991	1996	2001	2006	1991	1996	2001	2006
Assault	1.59	1.50	1.24	1.08	16.89	16.48	13.40	13.92	9.40	9.08	9.27	7.75
Burglary	5.37	5.61	5.11	4.42	31.27	33.97	26.42	20.94	17.16	16.52	19.33	21.12
Other	0.19	0.51	0.33	0.85	5.93	4.46	3.85	6.49	3.20	11.44	8.58	13.11
Robbery	1.02	1.19	0.92	1.09	7.11	8.33	4.01	5.04	14.42	14.25	22.84	21.64
Theft from vehicle	3.81	2.42	2.14	2.81	33.87	33.65	25.76	23.29	11.25	7.20	8.29	12.06
Theft	2.30	2.08	1.31	1.06	27.56	28.63	18.49	15.53	8.34	7.25	7.07	6.81
Theft of vehicle	4.19	5.03	4.54	3.91	17.06	22.50	18.78	14.10	24.57	22.34	24.16	27.77
Total	4.35	4.04	3.55	3.25	52.79	55.04	47.13	43.72	8.25	7.34	7.53	7.44

Scale in a Canadian context

- Census Tract Boundaries
- ⋯ Street Segments
- Dissemination Area Boundaries



0 0.5 Kilometers

Table 4. Indices of Similarity, Census Tracts

	1991–1996	1996–2001	1991–2001
Assault	.346	.318	.300
Burglary	.173	.218	.155
Robbery	.282	.364	.327
Sexual assault	.455	.409	.509
Theft	.199	.218	.136
Theft of vehicle	.282	.227	.300
Theft from vehicle	.091	.218	.146

Table 5. Indices of Similarity, Dissemination Areas

	1991–1996	1996–2001	1991–2001
Assault	.365	.357	.335
Burglary	.284	.288	.299
Robbery	.624	.675	.662
Sexual assault	.715	.753	.691
Theft	.377	.271	.237
Theft of vehicle	.313	.332	.332
Theft from vehicle	.224	.332	.261

Table 6. Indices of Similarity, Street Segments

	1991–1996	1996–2001	1991–2001
Assault	.659	.659	.659
Burglary	.537	.557	.567
Robbery	.866	.856	.875
Sexual assault	.920	.941	.919
Theft	.534	.559	.577
Theft of vehicle	.638	.577	.659
Theft from vehicle	.408	.445	.442

Table 7. Indices of Similarity, Nonzero Census Tracts

	1991–1996	1996–2001	1991–2001	Percentage of Census Tracts Retained
Assault	.321	.264	.274	96.4
Burglary	.149	.224	.140	97.3
Robbery	.238	.343	.286	95.5
Sexual assault	.438	.391	.476	95.5
Theft	.194	.213	.121	98.2
Theft of vehicle	.269	.250	.287	98.2
Theft from vehicle	.056	.222	.148	98.2

Table 8. Indices of Similarity, Nonzero Dissemination Areas




	1991–1996	1996–2001	1991–2001	Percentage of Dissemination Areas Retained
Assault	.321	.328	.294	94.2
Burglary	.257	.265	.279	96.8
Robbery	.399	.498	.458	63.1
Sexual assault	.509	.579	.471	57.6
Theft	.298	.253	.221	96.9
Theft of vehicle	.291	.298	.294	95.7
Theft from vehicle	.197	.311	.239	96.9

Table 9. Indices of Similarity, Nonzero Street Segments

	1991–1996	1996–2001	1991–2001	Percentage of Street Segments Retained
Assault	.340	.351	.326	38.2
Burglary	.327	.355	.372	63.8
Robbery	.387	.385	.427	12.7
Sexual assault	.518	.516	.501	9.4
Theft	.291	.343	.354	56.6
Theft of vehicle	.414	.325	.424	49.5
Theft from vehicle	.206	.326	.253	63.9

Ecological fallacy and MAUP

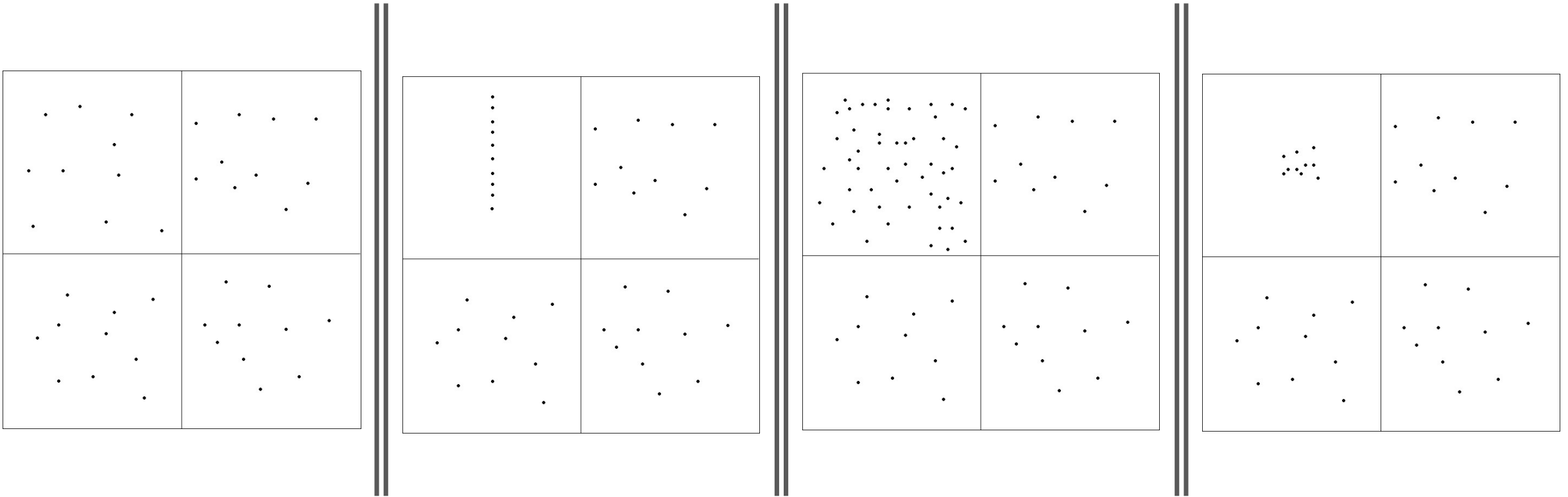
- Ecological fallacy
 - What is true of the whole is not necessarily true of its parts
- Atomistic fallacy
 - What is true of the part is not necessarily true of the whole
- Modifiable areal unit problem (MAUP)
 - What we have alluded to above
 - Change your spatial scale and your results can (drastically) change
 - Been fine in criminology (as far as we know), but anything can happen

 Sexual Assault, Census Tract Boundaries
Sexual Assault, 1991 - 2001
 2001 > 1991
 2001 < 1991
No Significant Change



1 0 1 Kilometers





A hot spot: to be or not to be?

Spatial scale and risk

In short...

- The scale you measure at impacts risk
- To paraphrase Sherman et al. (1989):
 - There are safe places in dangerous neighbourhoods and dangerous places in safe neighbourhoods
- Scale matters for the measurement of risk

Data sources for measuring risk

Census

- Based on where people live, not where they are

Social media (and other) data

- Great but have limitations (e.g. Twitter and OpenCellID)

Google Street View

- A lot of computing science people use these, but poorly

City websites

- Can be a valuable resource

An example: Vancouver Open Data Catalogue

Datasets by theme

[All datasets](#)



[Business and economy](#)



[Culture and education](#)



[Demographics](#)



[Food and housing](#)



[Geography and imagery](#)



[Government and finance](#)



[Parks, recreation, and pets](#)



[Property and development](#)



[Safety](#)



[Streets and transportation](#)



[Sustainability](#)



[Water and sewer](#)

A criminological example

Table 1. Descriptive statistics – crime counts and place attractors.

	Count (n)	Mean	Minimum	Maximum	SD
Residential burglary	2,140	0.23	0.00	8.00	0.60
Commercial burglary	2,689	0.21	0.00	23.00	0.90
Theft of vehicle	1,972	0.11	0.00	6.00	0.40
Theft from vehicle	12,372	0.98	0.00	116.00	3.90
Theft	13,475	0.44	0.00	276.00	6.22
Banks	144	0.01	0.00	4.00	0.14
Car parkades	318	0.02	0.00	4.00	0.19
Check-cashing stores	41	0.00	0.00	3.00	0.07
Community centres	27	0.00	0.00	1.00	0.05
Convenience stores	278	0.02	0.00	4.00	0.17
Gas stations	77	0.01	0.00	1.00	0.08
Liquor stores	100	0.01	0.00	3.00	0.10
Non-profit housing	232	0.02	0.00	5.00	0.17
Parks	222	0.02	0.00	2.00	0.13
Restaurants (Liquor)	1,225	0.09	0.00	11.00	0.54
Restaurants (No Liquor)	561	0.04	0.00	5.00	0.27
Schools	113	0.01	0.00	2.00	0.10
Apartments	2,746	0.24	0.00	32.00	1.09
Bus stops	1,790	0.14	0.00	6.00	0.45
Rental units (By-law)	372	0.03	0.00	5.00	0.21
Residential/commercial	232	0.02	0.00	5.00	0.15
Retail dealers	136	0.21	0.00	73.00	1.34
Second-Hand dealers	3,135	0.01	0.00	4.00	0.12
Skytrain stations	22	0.00	0.00	1.00	0.04
Streetlights	56,042	4.28	0.00	115.00	4.14
Central business district	619	0.05	0.00	1.00	0.21

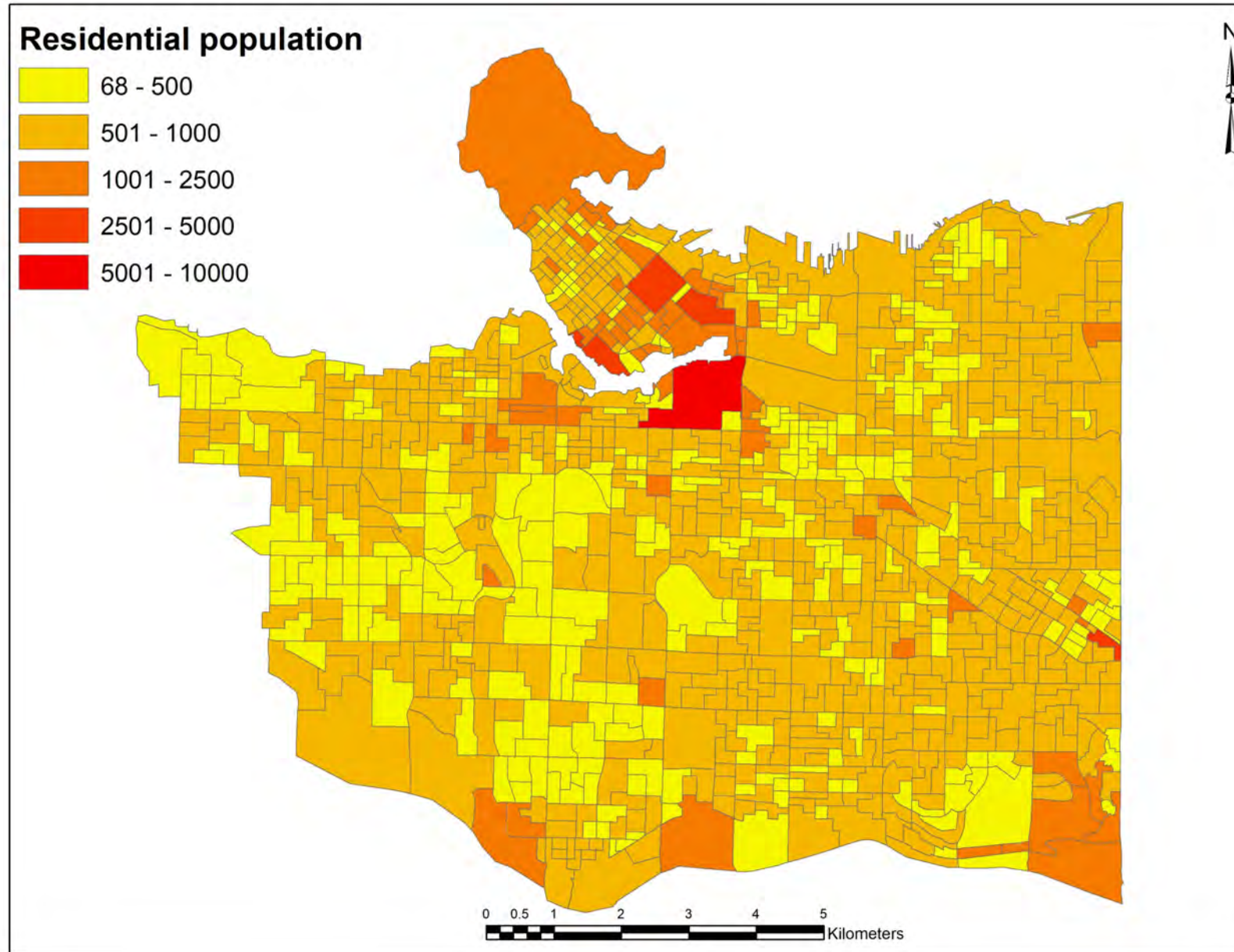
Issues to consider

- These are measured at the address level
- Can be a lot of work to gather, but worth the effort
- Community-level factors still matter...the neighbourhood is not dead!
 - Sorry John Eck!!
- Can include more standard socio-demographic/economic variables
 - Can consider multi-level models, as a number of people have

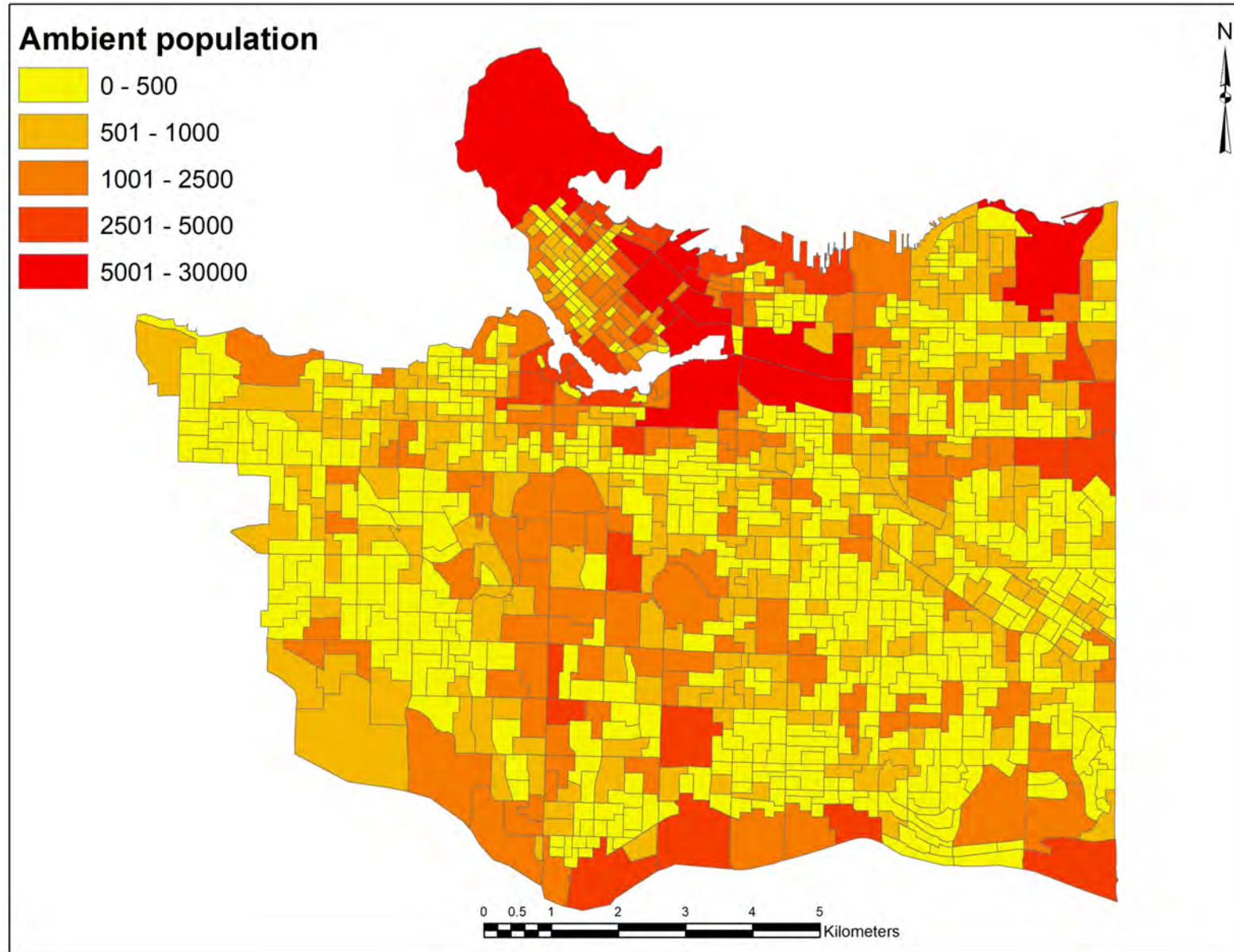
OpenCellID

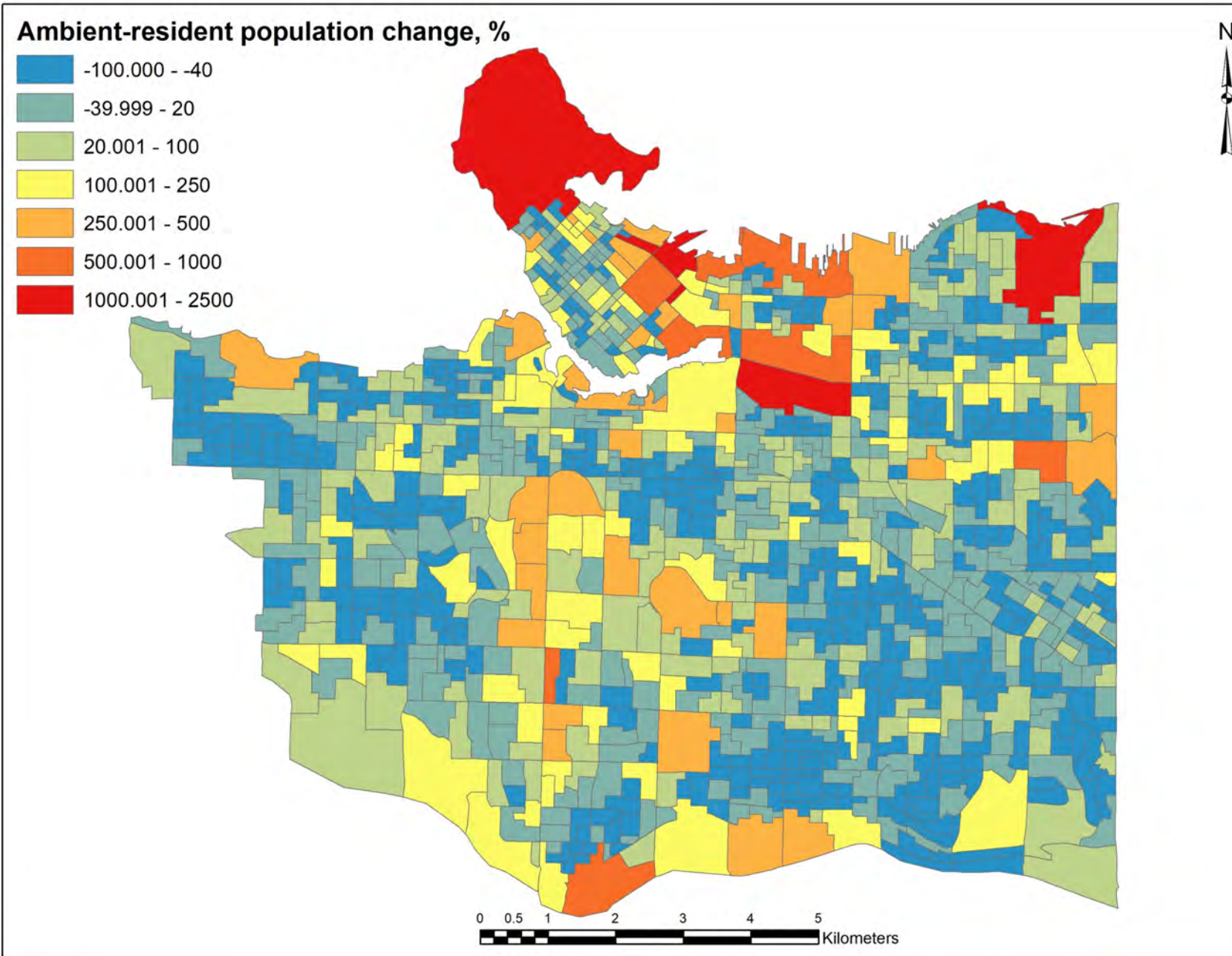
- What it is and what isn't
- NOT call volume or mobile phone pinging measurement
- The count of cellular towers
- Why I think it is a good measure of the ambient population

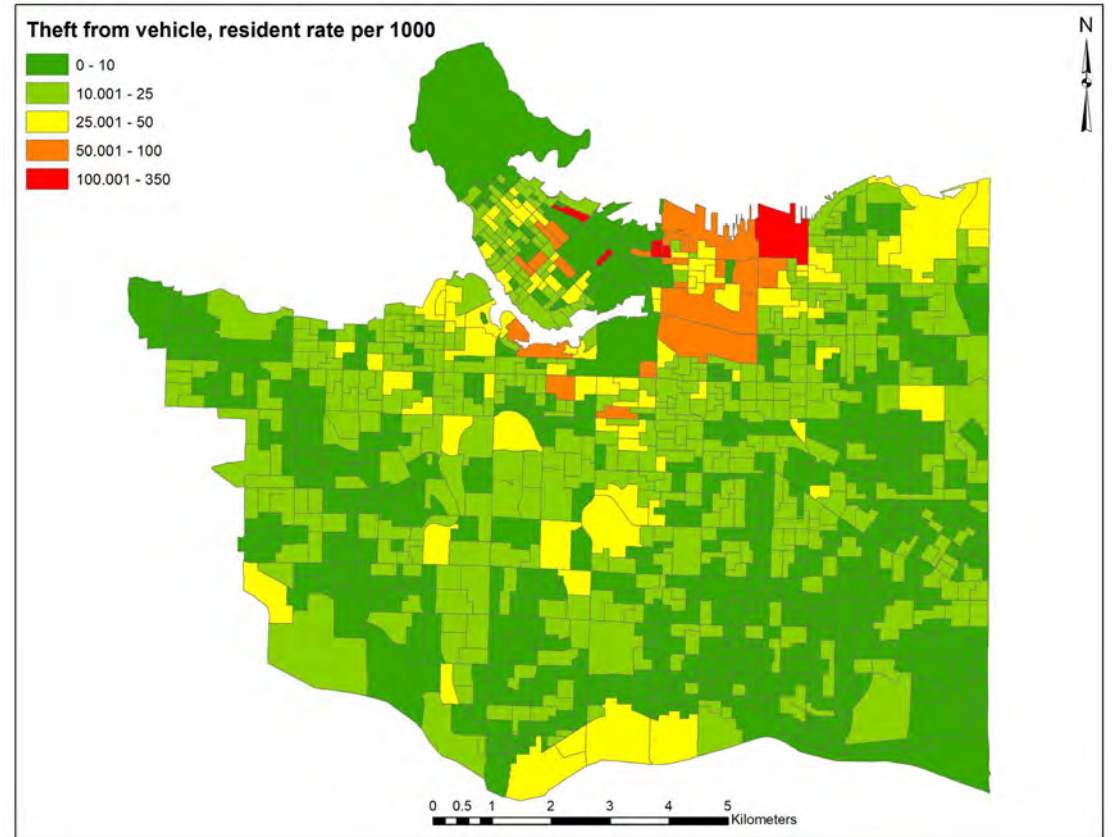
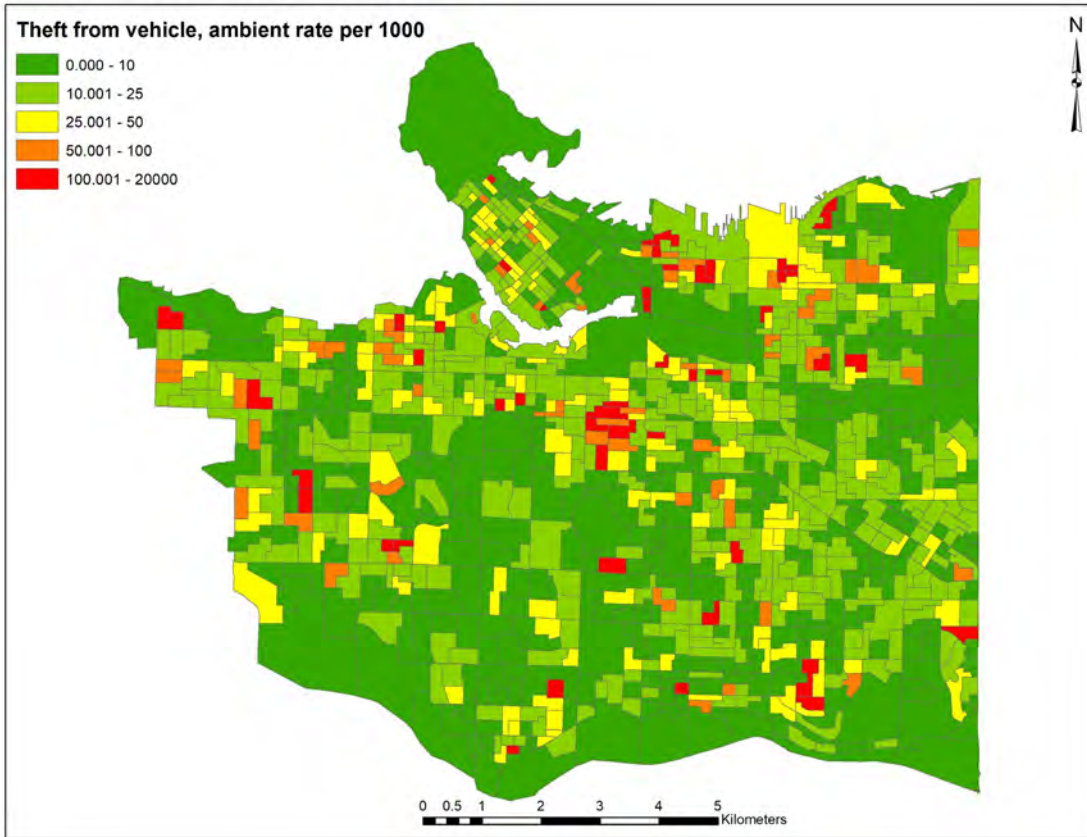
Vancouver, 2016 (640,000)



Vancouver, 2016 (800,000)







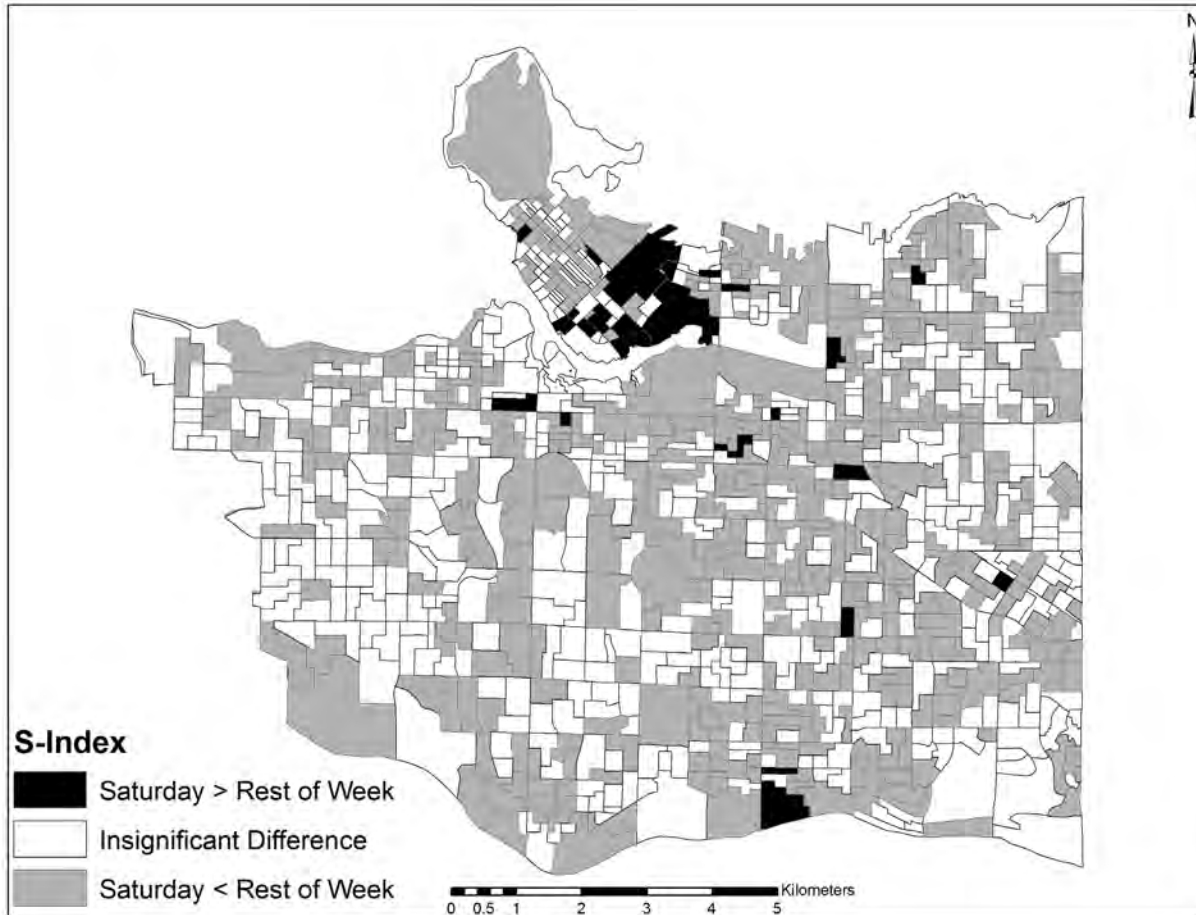
Data and measuring risk

Risk of what?

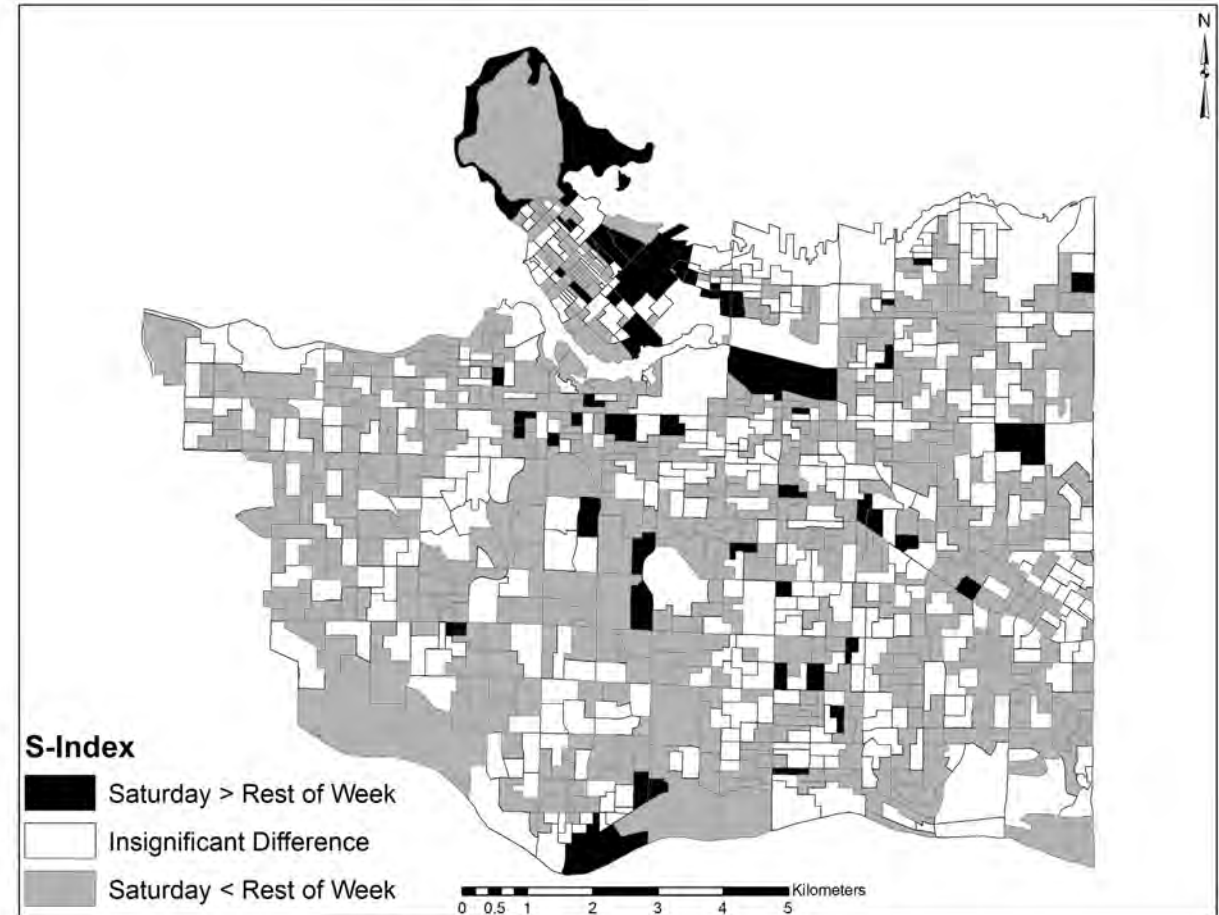
Risk for whom?

Risk also changes throughout
the day, week, month, and year!

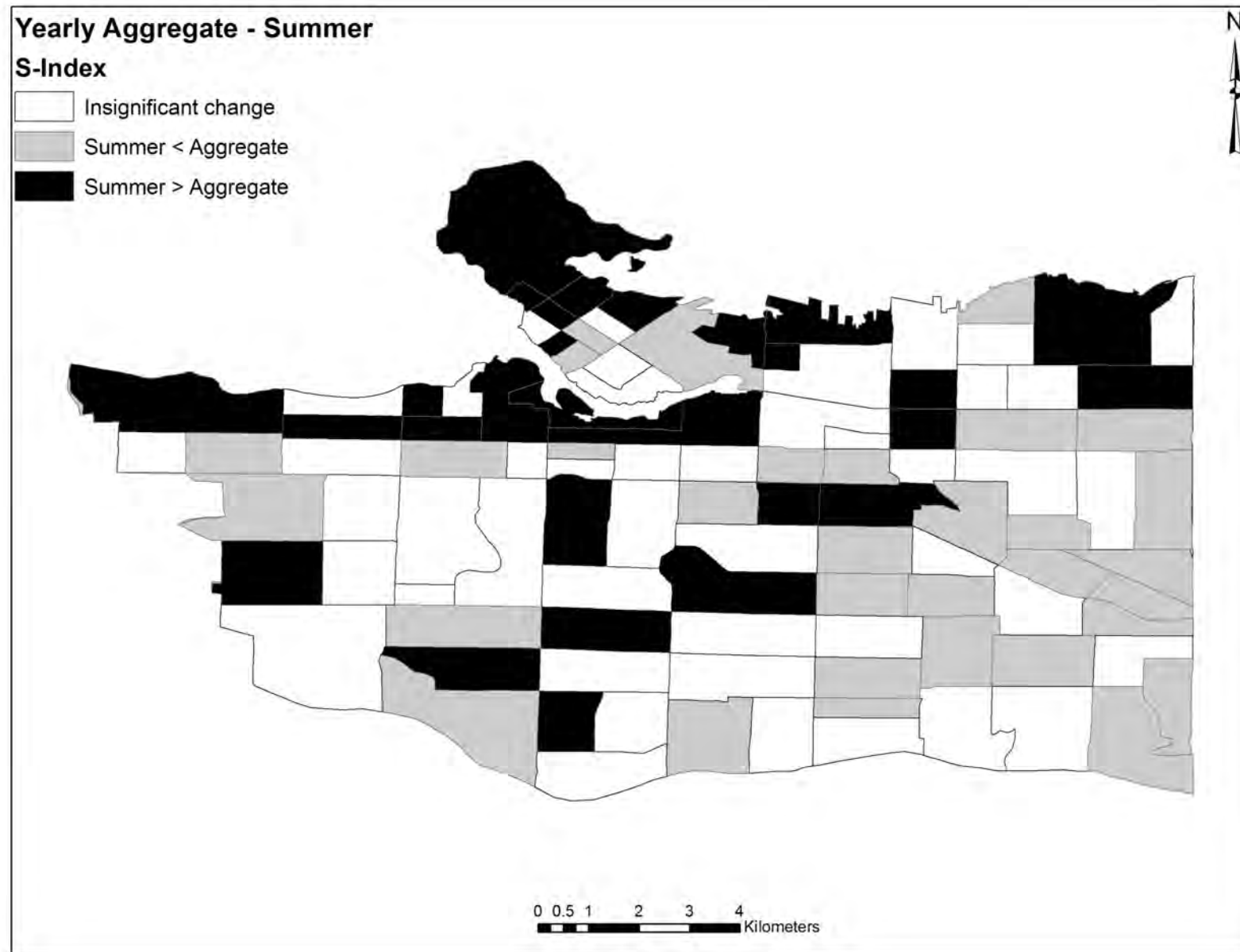
Assault



Theft from vehicle



Changing spatial patterns in summer



So think
carefully when
you are
measuring risk

- Who is being captured?
- Where were they?
- When were they there? (time of day, day of year)
- Is this relevant for your measurement?

How to measure crime risk?

Crime counts

- Can be useful, but does not necessarily measure risk
- What is the time span for measuring those counts?

Crime rates

- Need to have the appropriate denominator
- We've seen what can happen when this changes

Location quotients

- Measures specialization
- Useful supplement to crime counts/rates

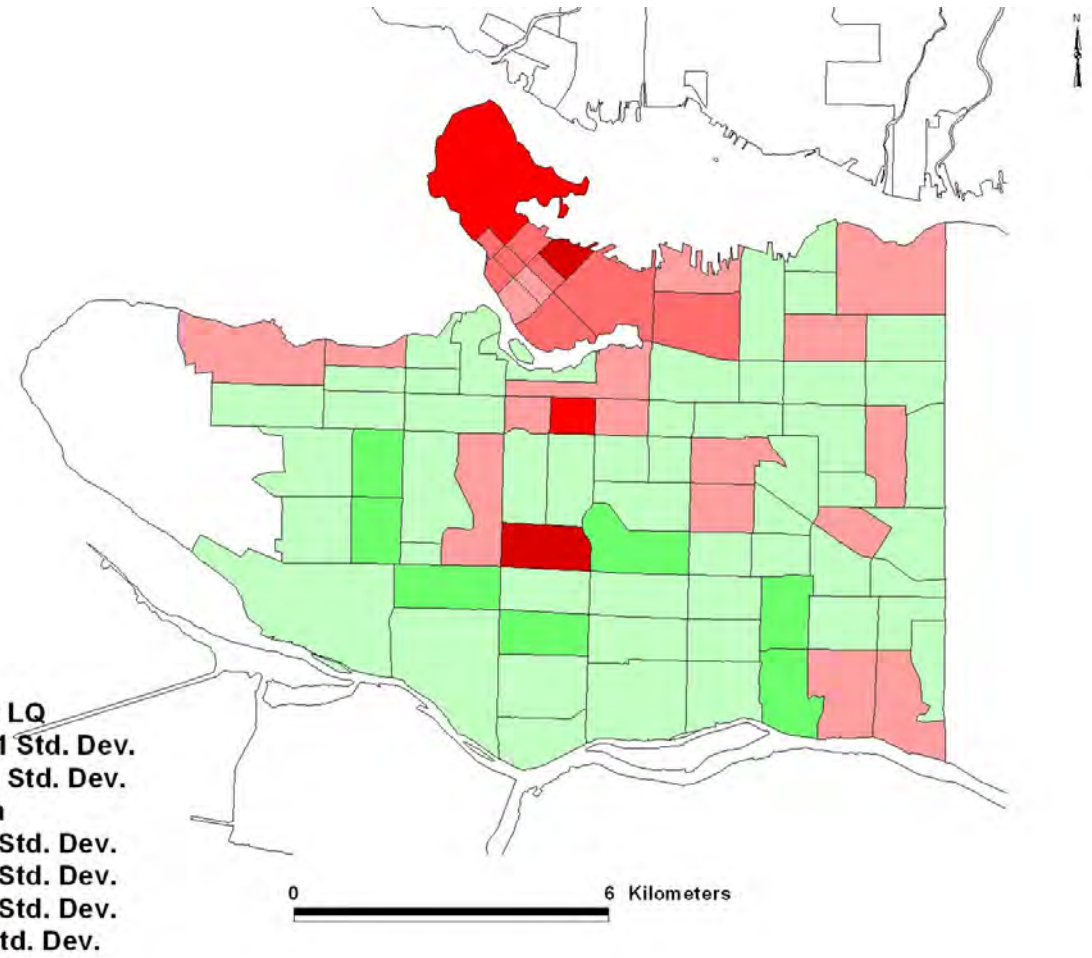
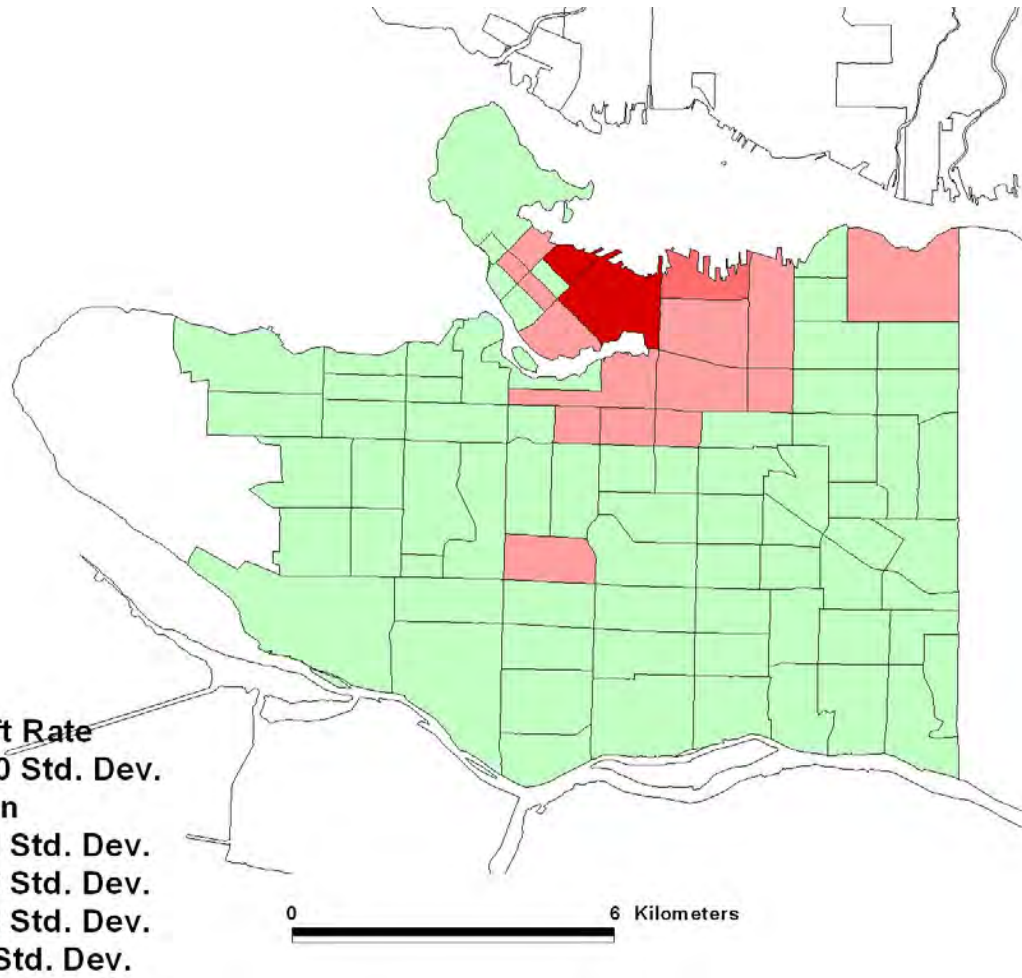
Location quotients

$$LQ_{in} = \frac{C_{in}/C_{tn}}{\sum_{n=1}^N C_{in} / \sum_{n=1}^N C_{tn}}$$

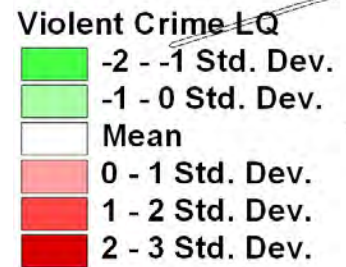
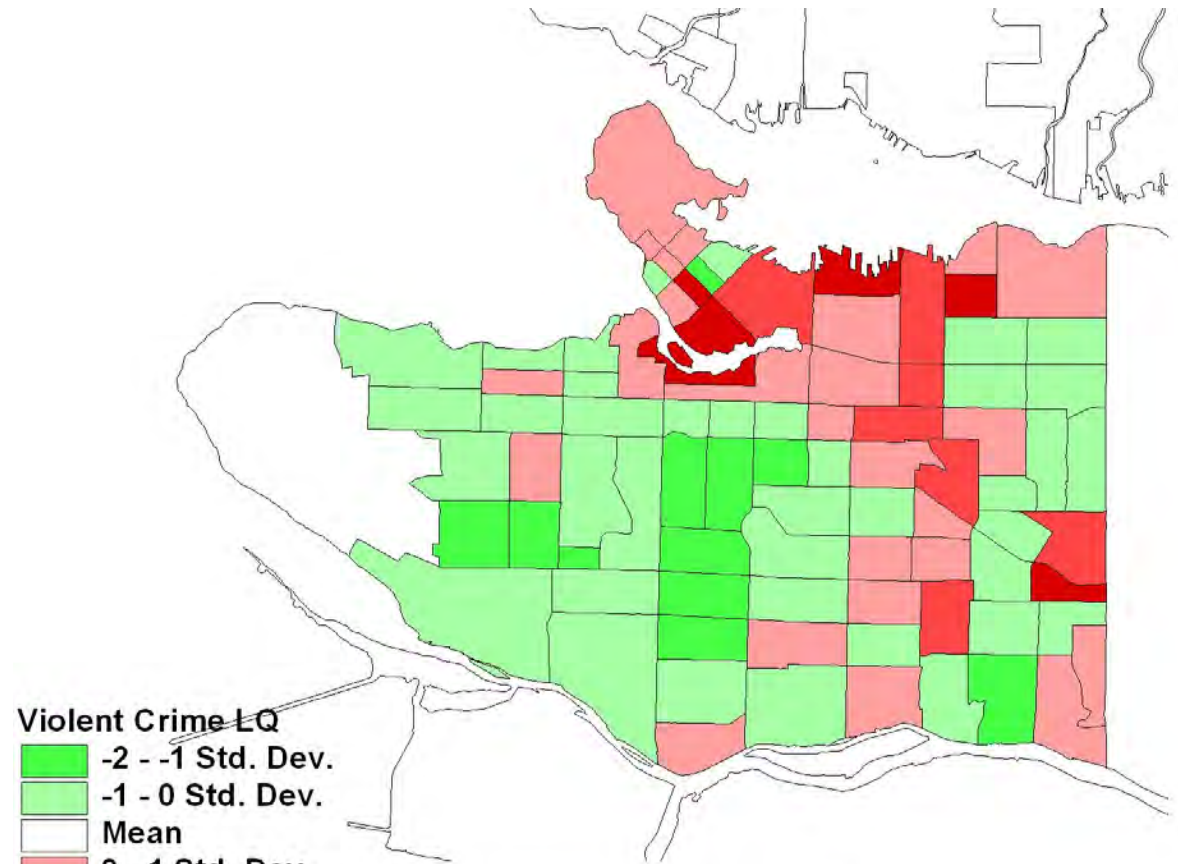
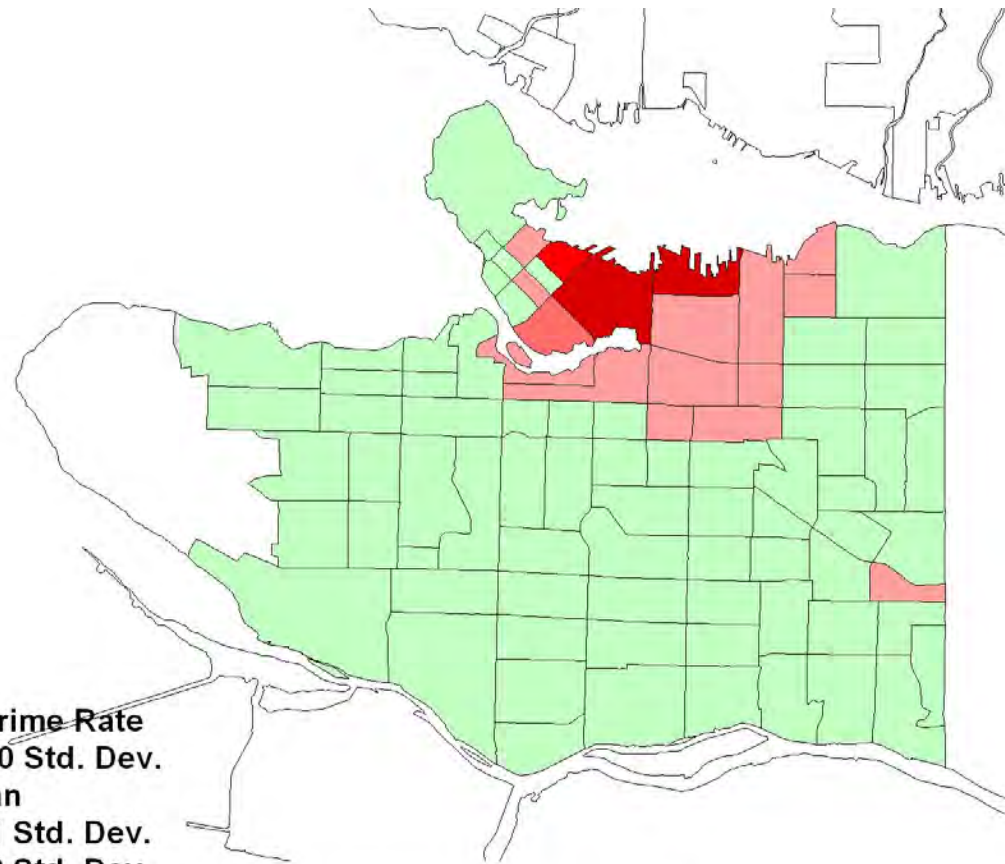
- C_{in} is the count of crime i in sub-region n
- C_{tn} is the count of all crimes in sub-region n
- N is the total number of sub-regions

- Very underrepresented areas, $0 \leq LQ \leq 0.70$;
- Moderately underrepresented areas, $0.70 < LQ \leq 0.90$;
- Average represented areas, $0.90 < LQ \leq 1.10$;
- Moderately overrepresented areas, $1.10 < LQ \leq 1.30$;
- Very overrepresented areas, $LQ > 1.30$

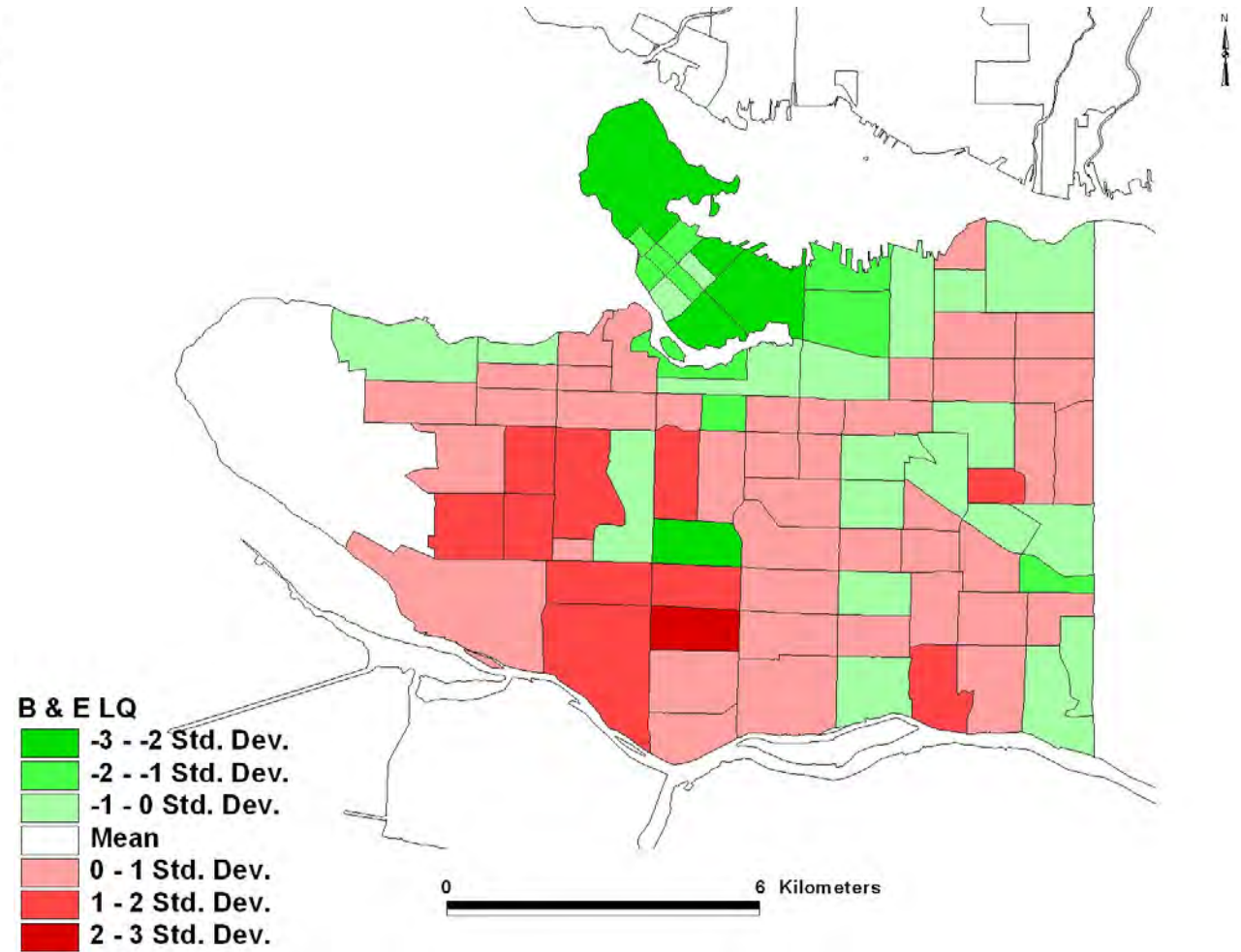
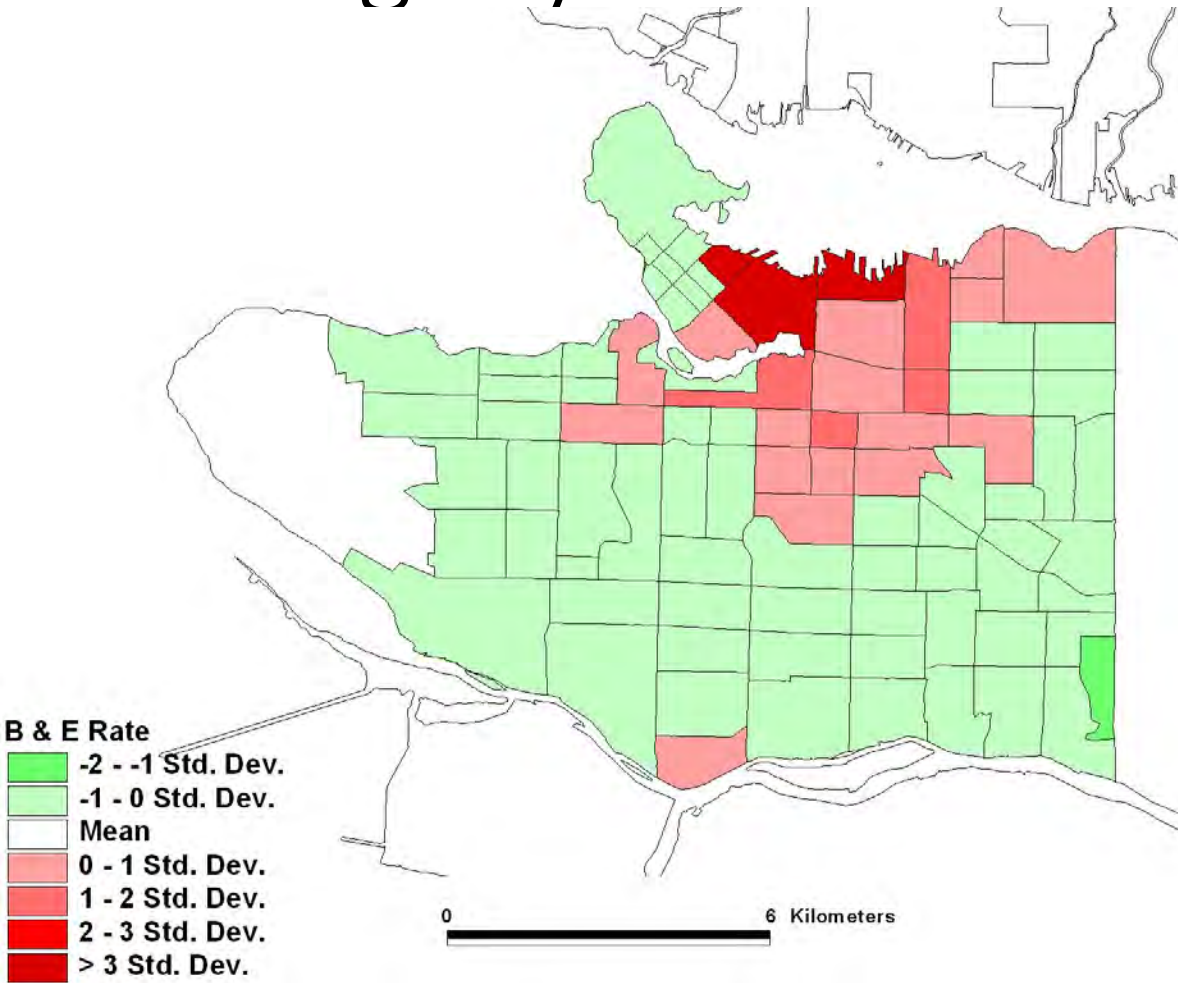
Theft of vehicle



Violence



Burglary



What does this all mean?

- There is so much potential for measuring risk with current data availability and methods
- Measuring risk spatial literally adds (at least) two dimensions to consider
- Need to think very carefully about what we measure
- Otherwise, we may impose more error or noise than signal
- This is the source of my current existential crisis in my research
 - Dark figure of crime and its impact on spatial patterns
 - What are we really measuring anywhere? Do people leave their characteristics behind?

Questions or comments?

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