School of Geography
FACULTY OF ENVIRONMENT

UNIVERSITY OF LEEDS

GeoCrimeData

Understanding Crime Context with Novel Geo-Spatial Data

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JISC

Outline

The GeoCrimeData Project

Police / Crime Analyst Requirements

Geospatial Data Sources and Methods

New Data

Preliminary Results

- Violent crime and twitter
- Burglary, house type and street accessibility

Conclusions

Motivation

Wide range of new, publicly available, data sources

- Road network data
- Land-use data
- Social network data

But these are rarely used by crime analysis

- What would analysts like to know?
- What are the barriers to using the data?

Focus (at this stage) on residential burglary

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Exploring Geospatial Data for Crime Analysis

Small (~£90k, 9 month) JISC-funded collaboration between the School of Geography in Leeds and the Applied Criminology Centre in Huddersfield

Aim: analyse existing spatial data, identify crime-relevant features and re-release for crime analysts.

For example:

- House visibility or type influences burglary risk
- Road traffic volume influences street robbery

Methodology:

- Identify crime analysts' needs
- Explore available spatial data
- Develop and use algorithms
- Re-release new data

User Needs Analysis

User survey

- Online survey to explore user needs and experiences with geospatial data
- 40% response rate (N = 33)
- Roughly 60/40 UK USA split
- Police (42%), academics (30%), Community Safety Partnerships (15%), Consultants (4%), Others (9%)

Follow-up workshop

- 50% split between academics and practitioners
- Detailed discussion of user requirements

Workshop Findings

Important environmental factors re. roads

- Road type (through road or cul-de-sac)
- Cul-de-sac type: linear, sinuous, true, leaky.
- Cul-de-sac with linked pathway?
- Volume of traffic outside road
- Volume of traffic at nearest junction
- Speed of traffic on road outside
- Access restrictions on road

Important factors re. buildings

- Visible from footpath?
- Footpath at rear?
- House Type
- Corner plot?
- Visible from: Road Junction, School, Park, Community Centre, Commercial Establishment
- Overlooked by other properties?

Data Sources

As with the US, in the UK/EU there is a drive towards making (spatial) data publicly available

- OS Open Data – the national mapping agency (Ordnance Survey) have released a large number of products
- data.gov.uk – government organisations releasing physical/social data that was previously held privately
- INSPIRE – EU directive making it mandatory for government organisations to formally describe their spatial data

Data are potentially extremely useful for exploring the social or environmental context surrounding crime.

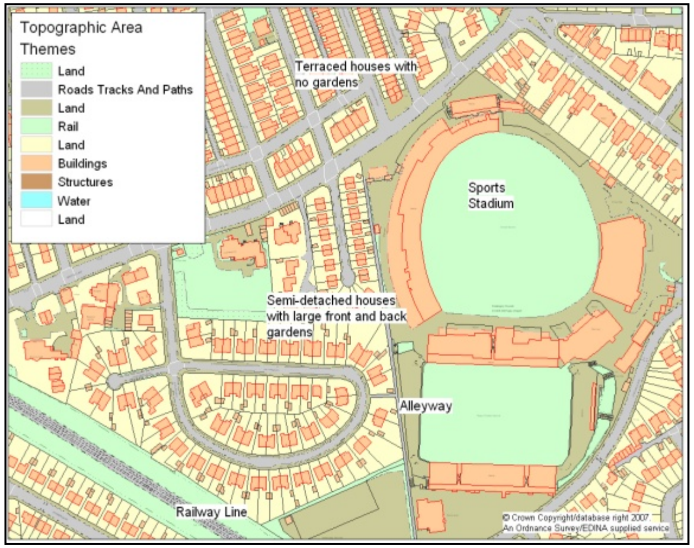
But: often large barriers to their use by crime analysts:

- Insufficient meta-data
- Unusual GIS data format
- Resources (time and software) required for spatial analysis

Data Sources: Examples

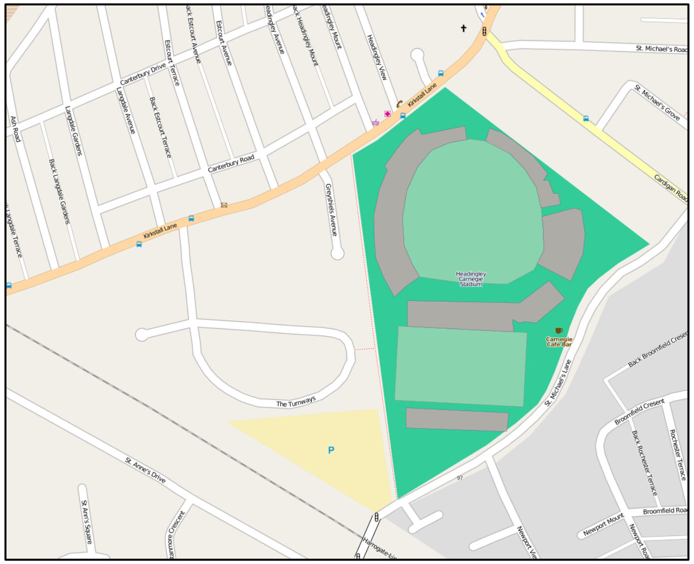
Land Use

- LandMap – Building heights and class
- OS MasterMap Topographic Area
- Generalised Land Use Database



Road Network

- OpenStreetMap (limited buildings)
- OS Strategi
- OS MasterMap Integrated Transport Network



Public transport

- National Public Transport Data Repository (NPTDR)
- National Public Transport Access Nodes (NaPTAN)

Physical disorder

- Derelict buildings

Geospatial Methods: Buildings

House Type

- Detached, semi detached, terraced, corner terrace, (flat)

House Isolation / Visibility

- Number of surrounding houses

Road Distance

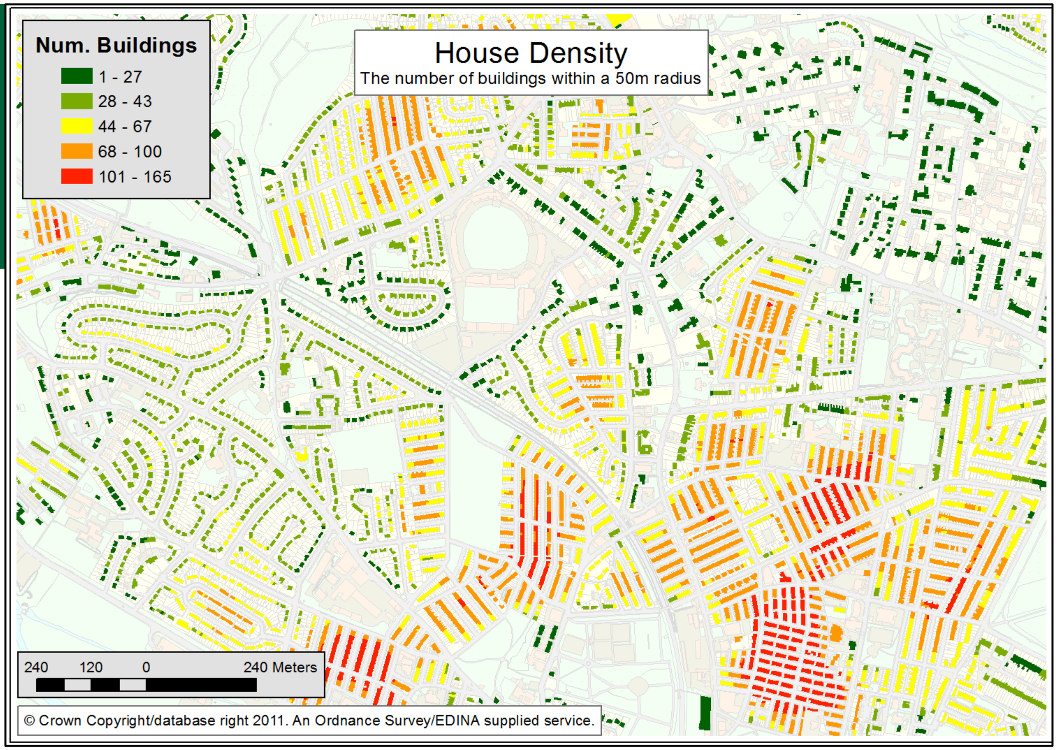
- Distance to nearest road or footpath

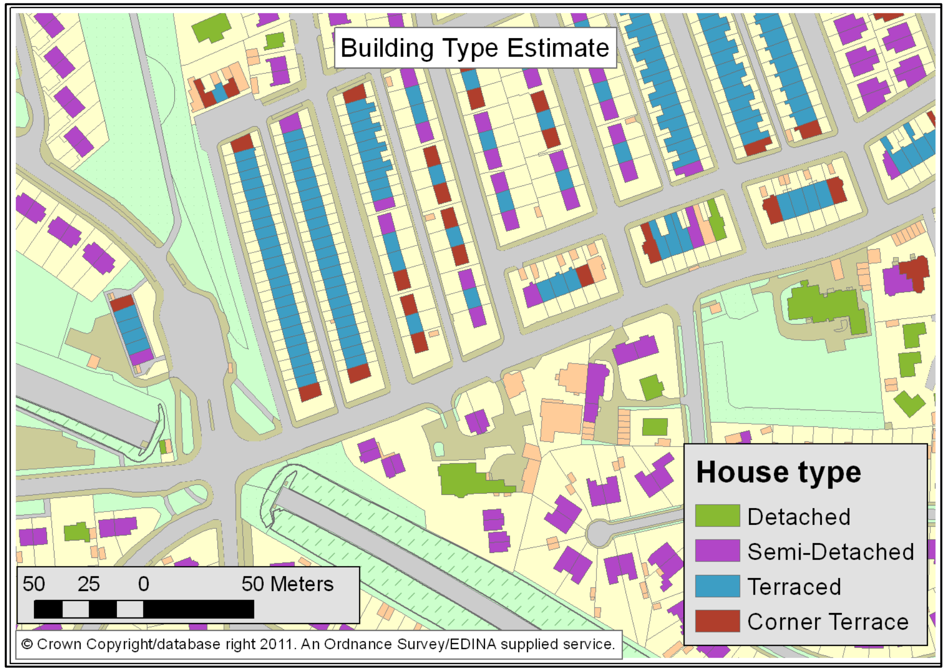
Vulnerability

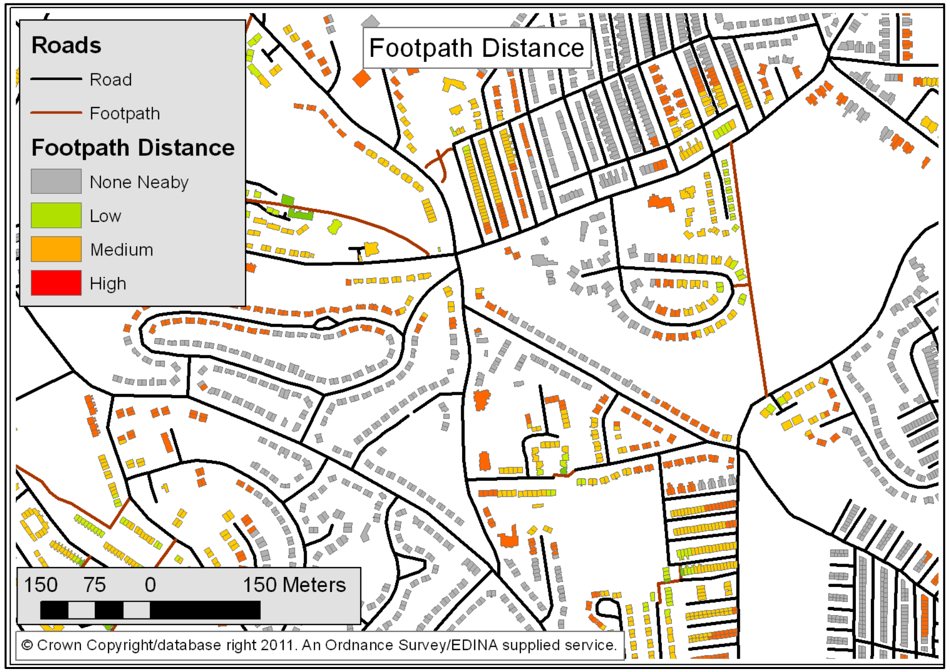
- Aim to create an overall measure of vulnerability

New Building Data

Data: MasterMap Topographic Area (commercial license)

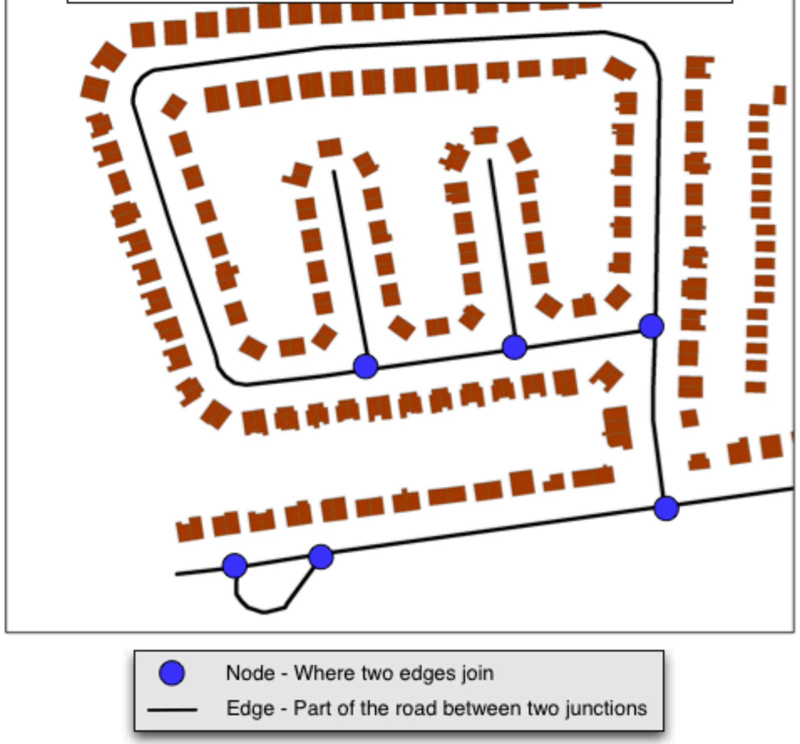






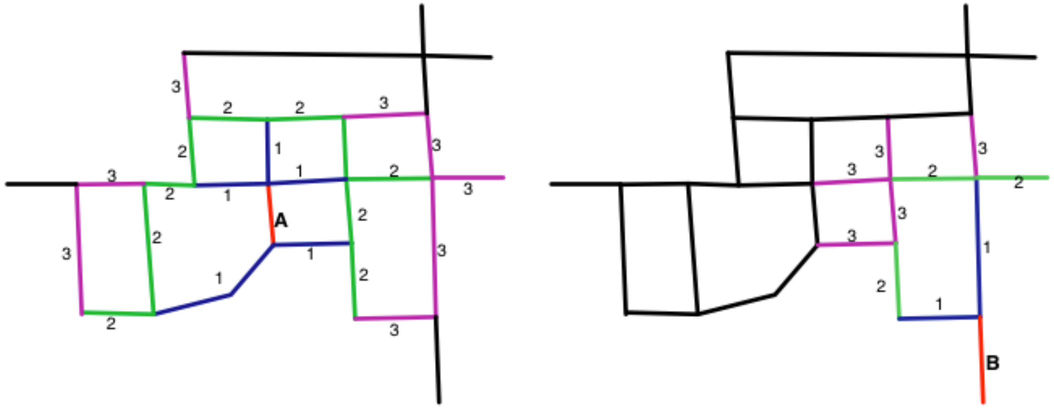
Space Syntax *Integration*

Creating a *graph* from a road network



Mean Path Depth Example

The diagrams illustrates how to calculate the *mean path depth* of the road highlighted red using a radius of 3. Edges coloured blue, green and purple can be reached from the starting edge within one, two and three steps respectively. All other edges are ignored.



Road A example

```
mpd = (1*5 + 2*9 + 3*8) / 22
    = 2.14
```

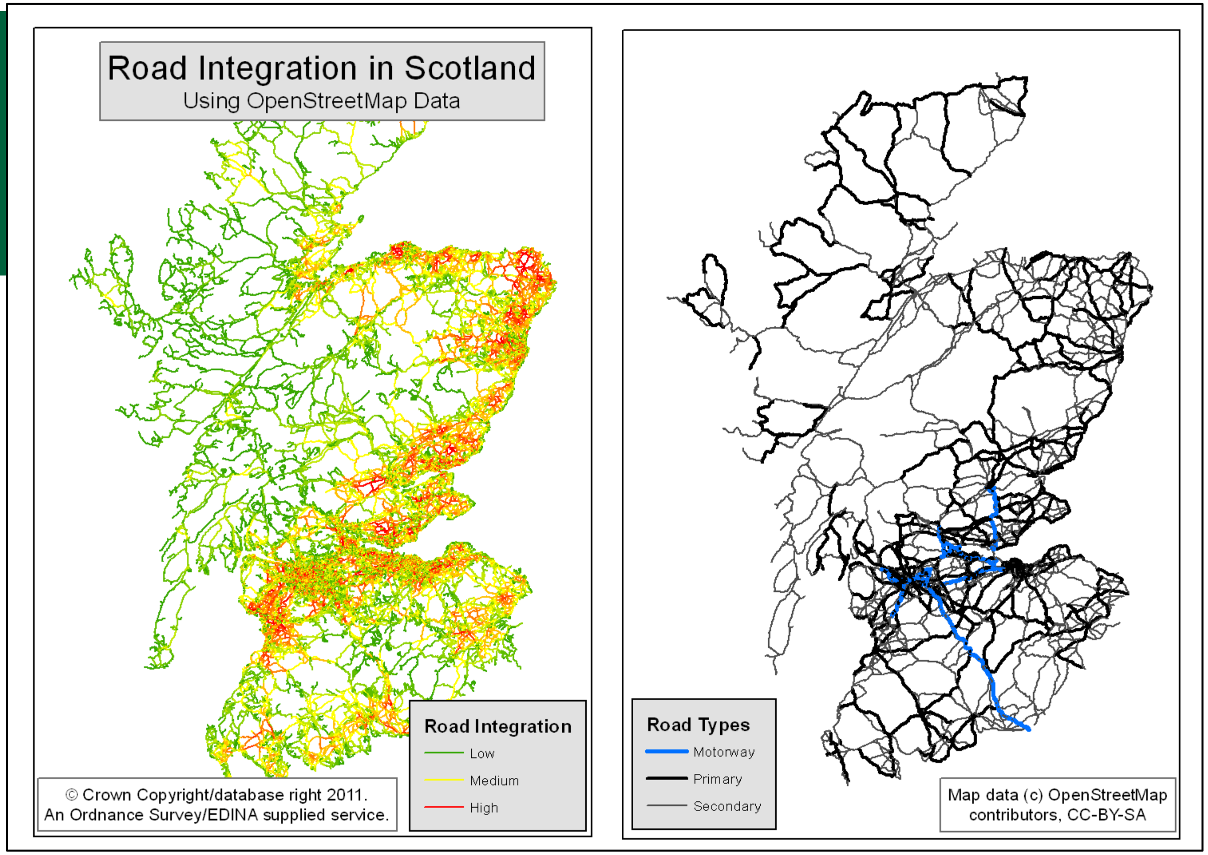
Road B example

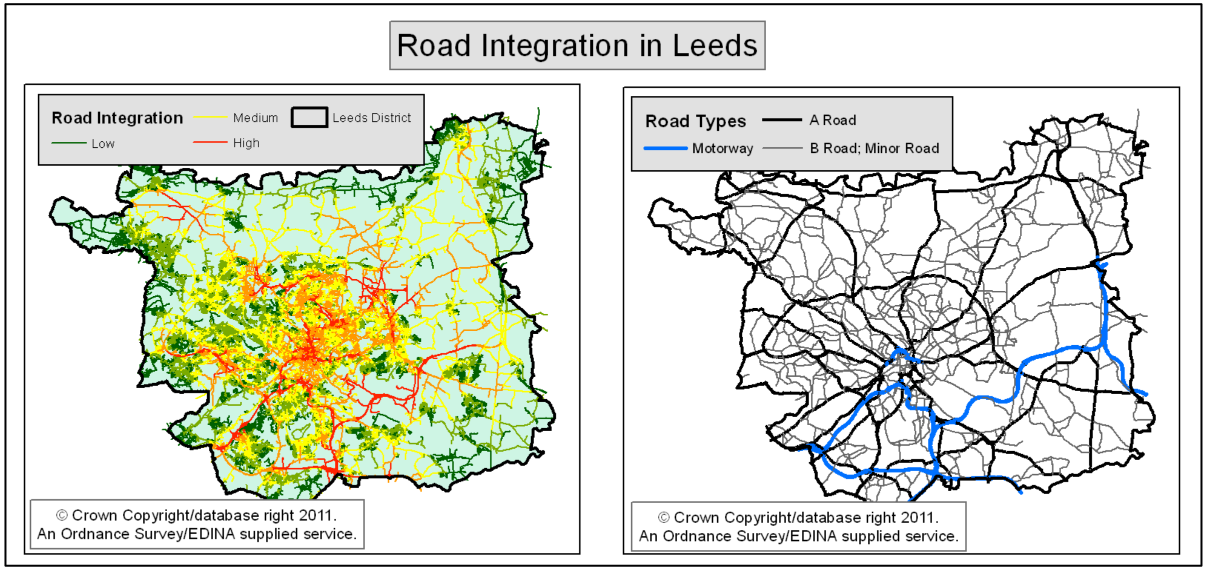
```
mpd = ( 1*2 + 2*3 +3*5) / 10
    = 2.3
```

New Road Data

OperStreetMap (free) and MasterMap ITN (commercial)

Calculate integration and mean-path-depth for GB (using OSM) and Leeds (using ITN)





Preliminary results: violent crime

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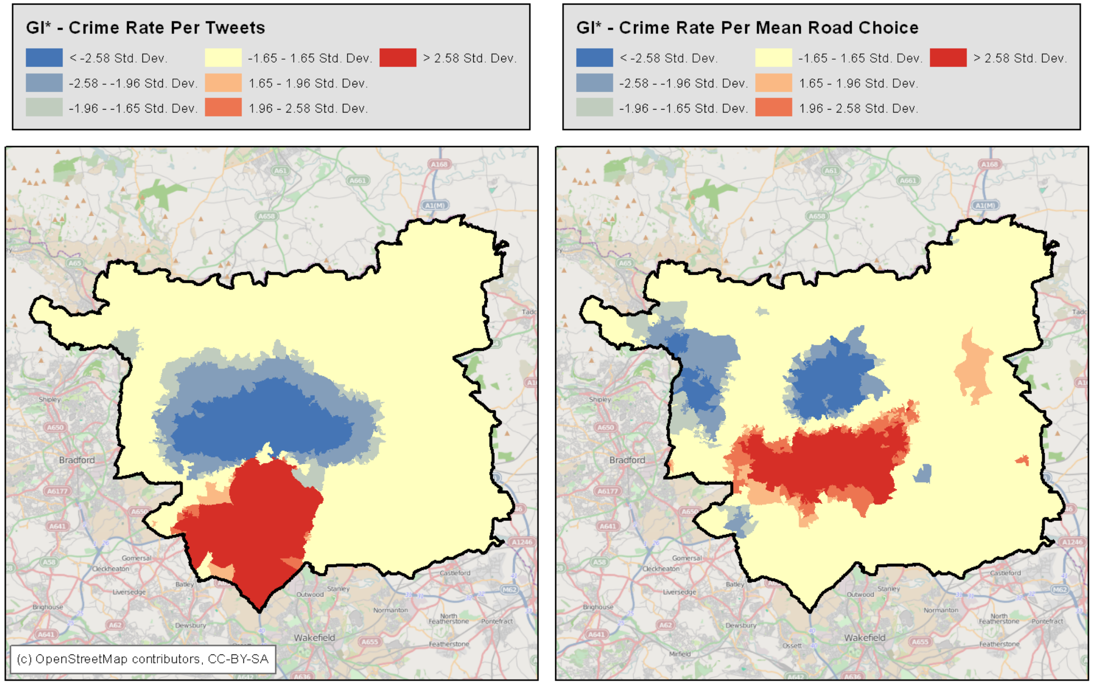
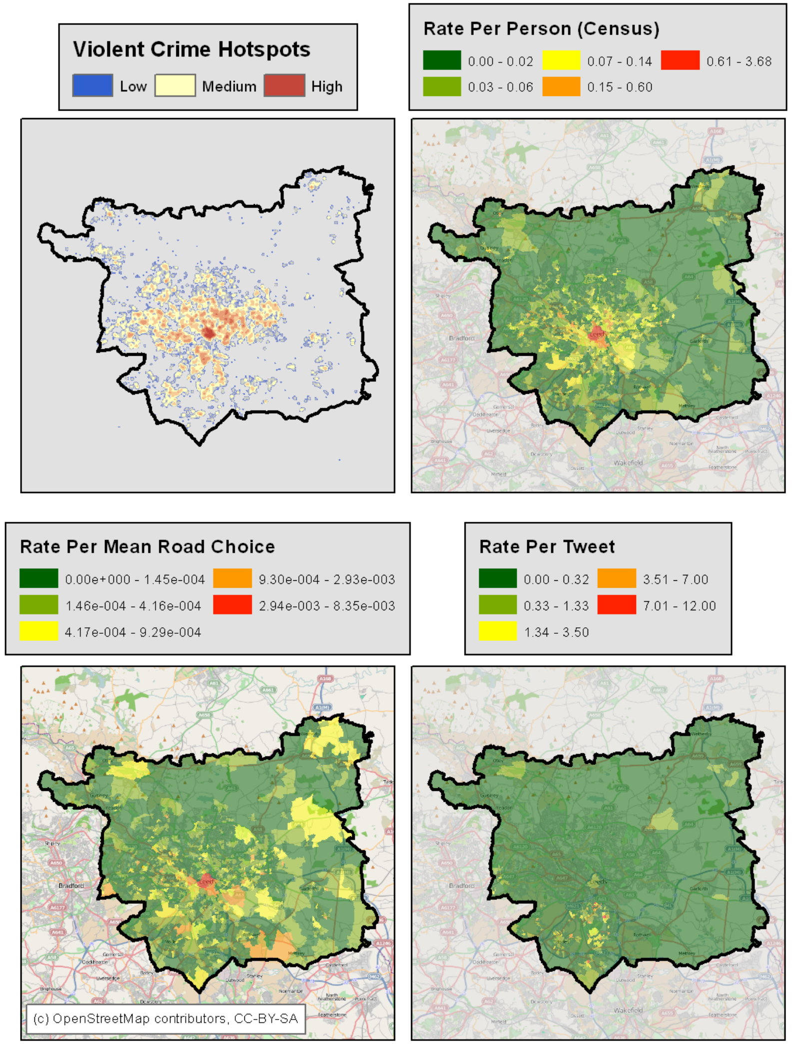
Explore violent crime using various (novel) populations at risk

- Street accessibility (traffic volume)
- Number of *tweets* (fluid population)

Rates of Violent Crime
Using Different Populations at Risk



Rates of Violent Crime
Using Different Populations at Risk



Preliminary results: burglary (I)

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Exploring Geospatial Data for Crime Analysis

Explore relationship between house type and residential burglary

- Are certain house types more at risk?
- And do community demographics have an effect?

Burglary rates by Housing Type by OAC Super Group

OAC Super Group	Burglary rate				
	Per 1,000 Detached	Per 1,000 Semis	Per 1,000 Terraced	Per 1,000 Corner	Per 1,000 Properties*
1. Blue-Collar Communities	32.2	25.1	14.4	22.4	22.5
2. City Living	93.4	64.5	78.5	83.6	76.4
3. Countryside	21.6	13.2	3.2	14.4	16.4
4. Prospering Suburbs	25.3	23.9	9.6	24.4	24.0
5. Constrained by Circumstances	88.1	31.3	27.1	29.6	33.6
6. Typical Traits	27.6	25.9	16.6	24.6	23.2
7. Multicultural	79.7	45.1	33.7	60.5	41.7
Leeds	33.6	28.7	27.5	33.2	29.7

* This figure excludes flats

Neighbourhood cohesion?

Low guardianship?

?

Affluence within disadvantage?

Preliminary results: burglary (II)

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Exploring Geospatial Data for Crime Analysis

Explore relationship between house type, residential burglary and street accessibility

- Does street accessibility influence house type burglary risk?

Burglary rates by Housing Type and Accessibility of Streets (mean accessibility per OA)

Street Accessibility Decile	Burglary rate				
	Per 1,000 Detached	Per 1,000 Semis	Per 1,000 Terraced	Per 1,000 Corner	Per 1,000 Properties*
Decile 1*	21.4	17.6	13.5	20.7	18.2
Decile 2	24.4	20.2	15.0	16.0	19.7
Decile 3	25.6	20.0	25.1	23.5	22.5
Decile 4	27.8	31.2	25.9	28.4	29.1
Decile 5	31.3	28.4	35.2	36.5	31.5
Decile 6	40.2	32.4	33.8	46.5	35.3
Decile 7	38.7	30.6	33.9	41.4	33.6
Decile 8	37.5	34.6	35.2	38.8	35.5
Decile 9	53.7	32.8	22.4	41.9	33.2
Decile 10**	65.6	38.0	26.2	44.2	40.3
Leeds	**33.6**	**28.7**	**27.5**	**33.2**	**29.7**

Notes: *10% of OAs with least accessible streets **10% of OAs with most accessible streets

Preliminary results: burglary (II)

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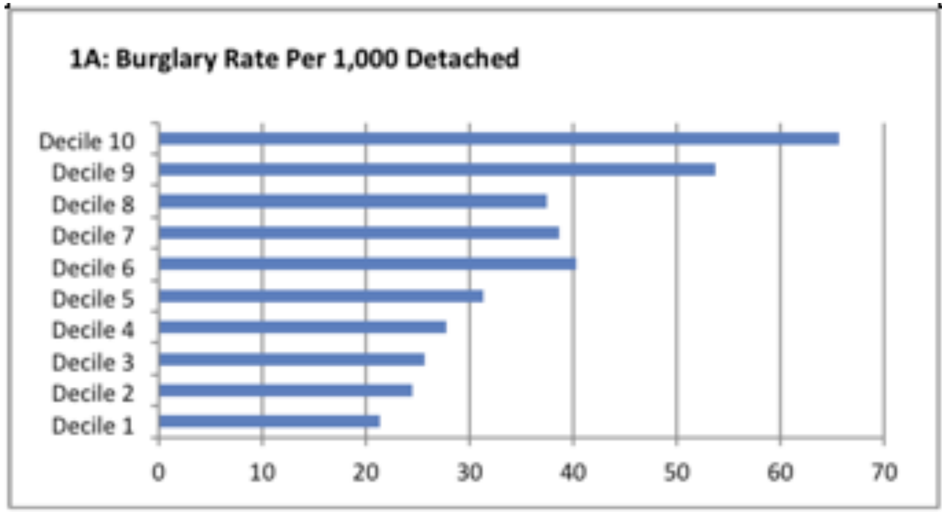

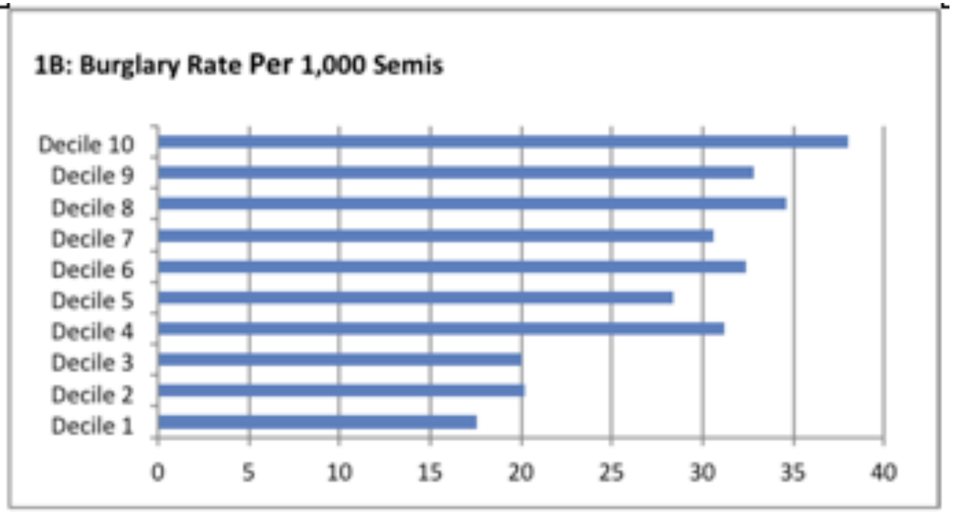

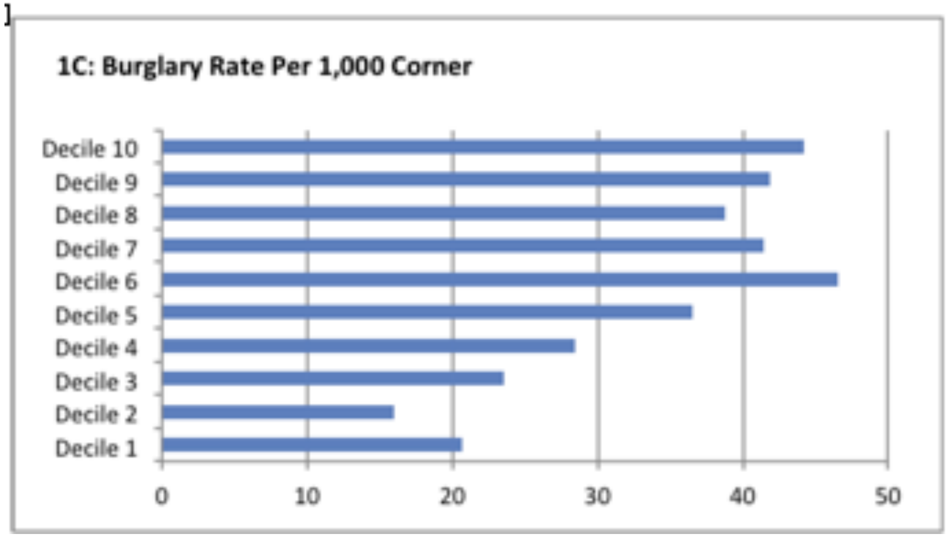

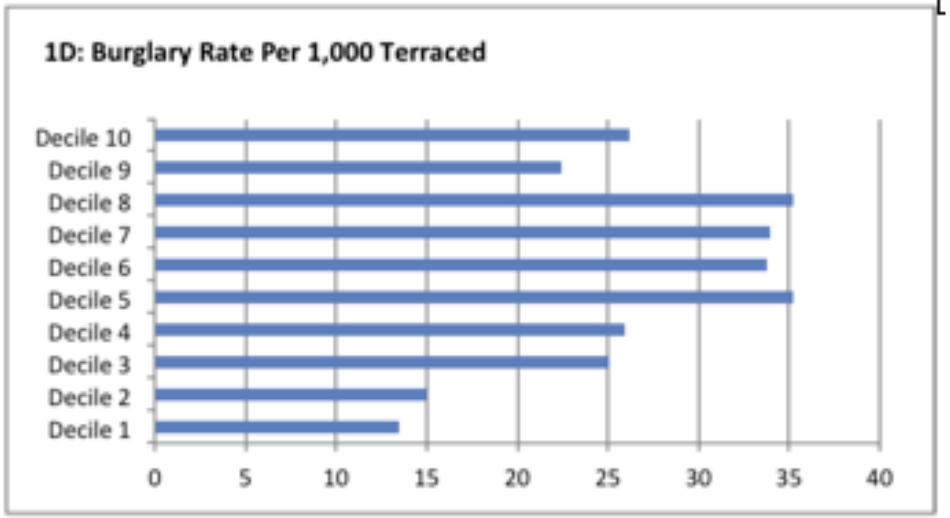

Future Work: Improvements

More accurate road *integration* calculations

- Jiang, B., and C. Liu (2009). Street-Based Topological Representations and Analyses for Predicting Traffic Flow in GIS. *International Journal of Geographic Information Science* 23 (9).

Further building geospatial analysis to estimate further useful attributes

- Footpath at rear (and leading to shops)
- Visible from: Road Junction, School, Park, Community Centre, Commercial Establishment

More detailed analysis of road networks, e.g. permeability, sinuosity

- Johnson, S., and K. Bowers (2009). Permeability and Burglary Risk: Are Cul-De-Sacs Safer? *Journal of Quantitative Criminology* 26 (1): 89–111.

Confidence in data: release publicly

- ‘Beta’ data already available

Conclusions

Potential offered by novel geospatial data for crime analysis

New insights that were not possible previously

Further analysis and validation required

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Thankyou

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