GIS4SG

Mapování a modelování kriminality I

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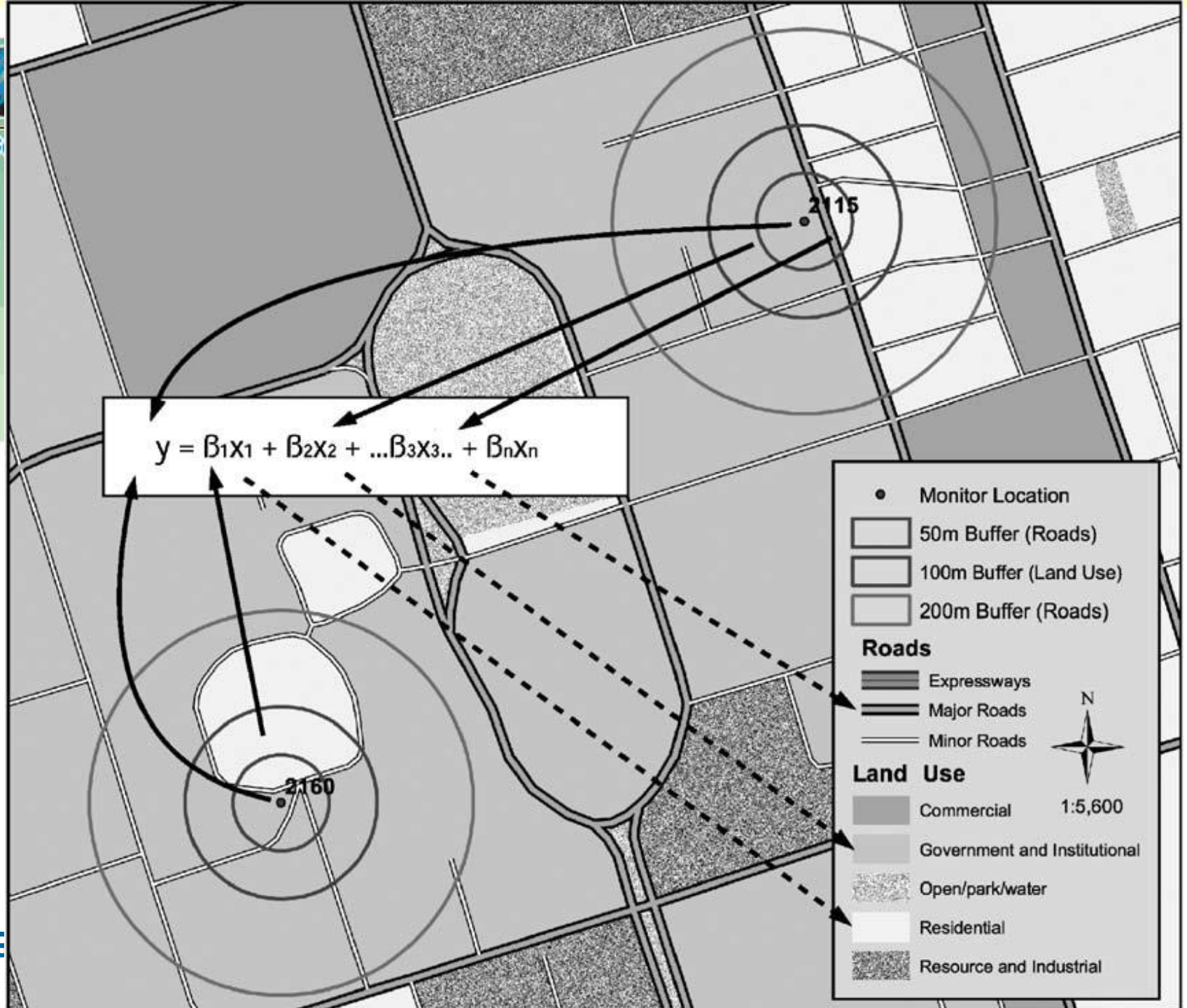
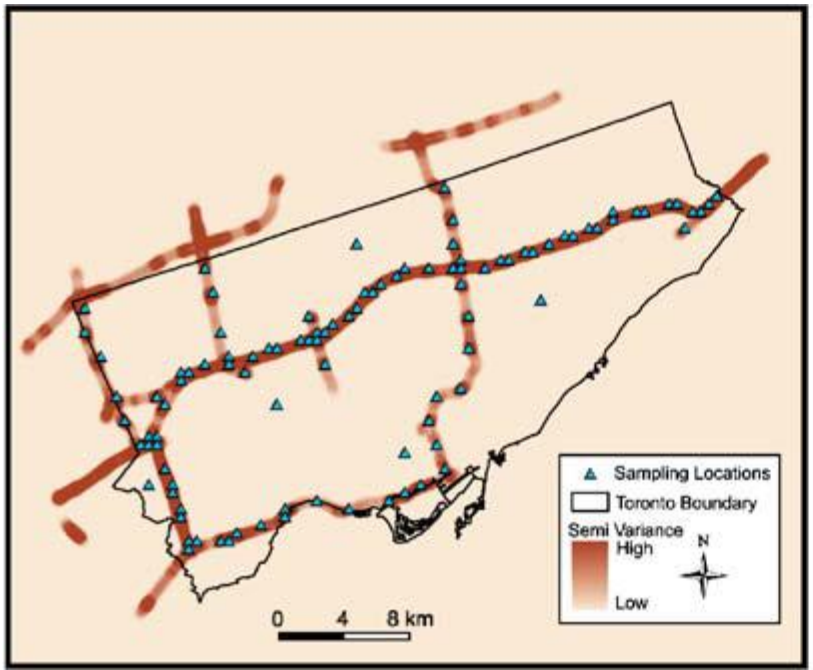
Dotazy Kanaroglou a kol.(2005)

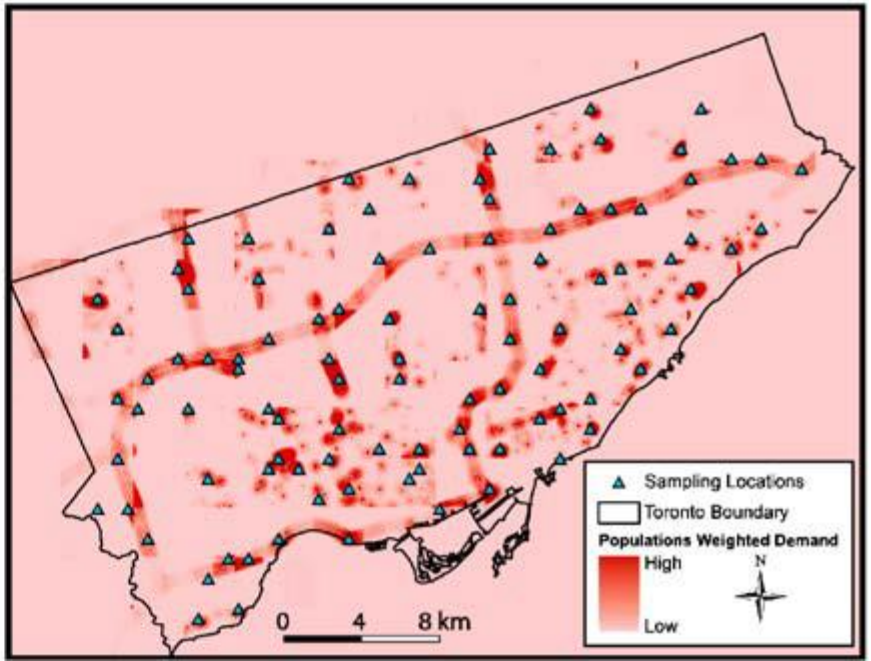
1. Jaká je motivace studie?
2. Jaká jsou cíle studie?
3. Čím se liší použitá metoda od předchozích studií?
4. Jaké faktory vstupují do výpočtu?
5. Kolik monitorovacích stanic bylo umístěno?
6. Byly měřeny skutečné zplodiny (znečištění) z dopravy?
7. Jak byl získán prvotní povrch znečištění (pollution surface)?
8. Jaká kritéria (2) byla uplatněna?
9. Byla užita skutečná data znečištění?


2115
2160
$y = \beta_1 x_1 + \beta_2 x_2 + \ldots \beta_3 x_3 .. + \beta_n x_n$
Monitor Location
50m Buffer (Roads)
100m Buffer (Land Use)
200m Buffer (Roads)
Roads
Expressways
Major Roads
Minor Roads
Land Use
Commercial
Government and Institutional
Open/park/water
Residential
Resource and Industrial
N
1:5,600

Dotazy Kanaroglou a kol.(2005)

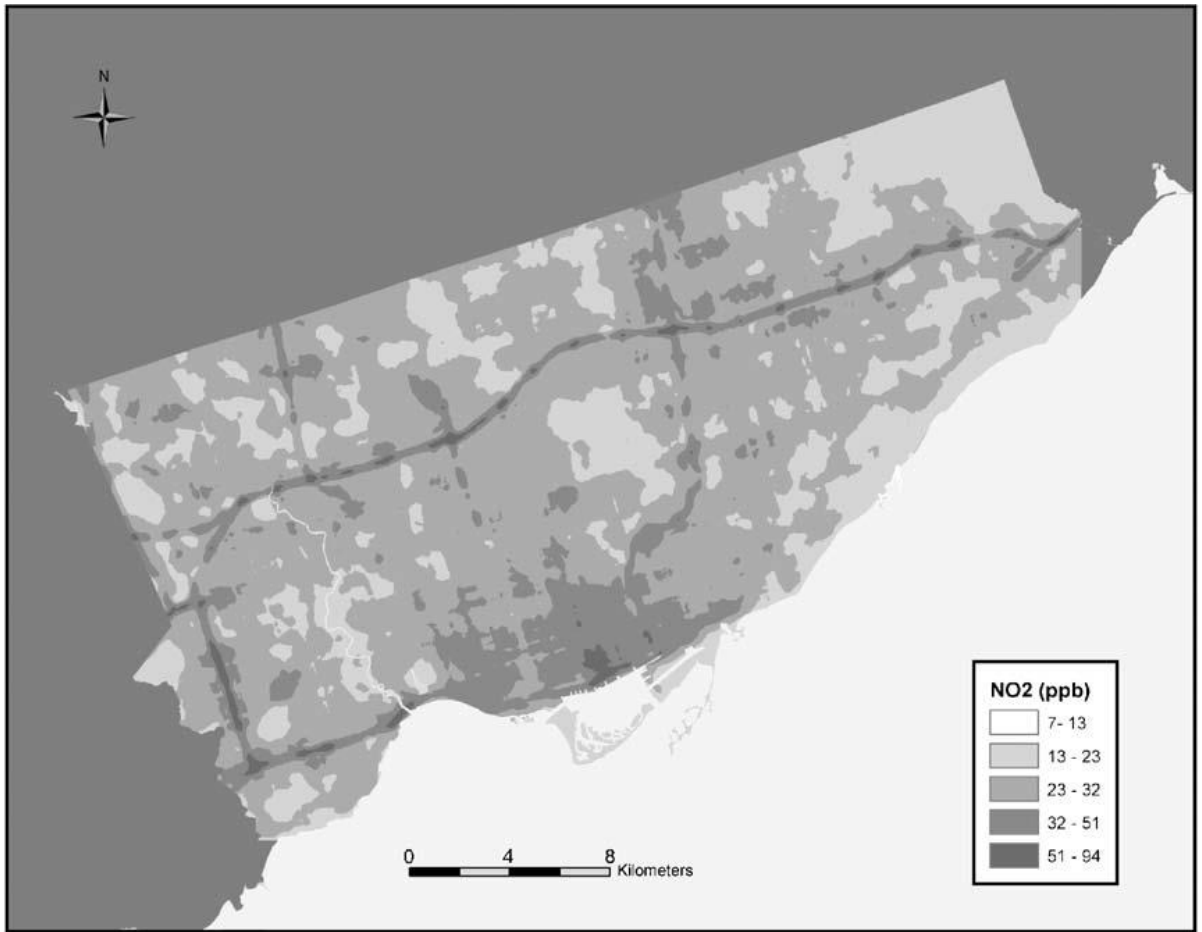
- Čím byla ovlivněna konečná L-A analýza?
- Jaká metoda byla vybrána pro analýzu?
- Jaká vzdálenost od zdroje znečištění byla vybrána jako hraniční?
- Jak se lišily vypočtené alternativy?





Dotazy Kanaroglou a kol.(2005)

- Co potvrdilo reálné nasazení senzorů?
- Jaké jsou podle vás slabé stránky použitého modelu?



CRIME MAPPING AND ANALYSIS

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The role of 'place' in crime

Two key considerations (Spencer Chainey)

- Crime has an inherent **geographical quality**
- Crime is **not randomly distributed**

Crime has an inherent geographical quality

The four dimensions of crime:

- **Legal** (a law must be broken).
- **Victim** (someone or something has to be targeted).
- **Offender** (someone has to do the crime).
- **Spatial** (it has to happen at a place - somewhere, in space and time).

Crime is not randomly distributed

If crimes were random:

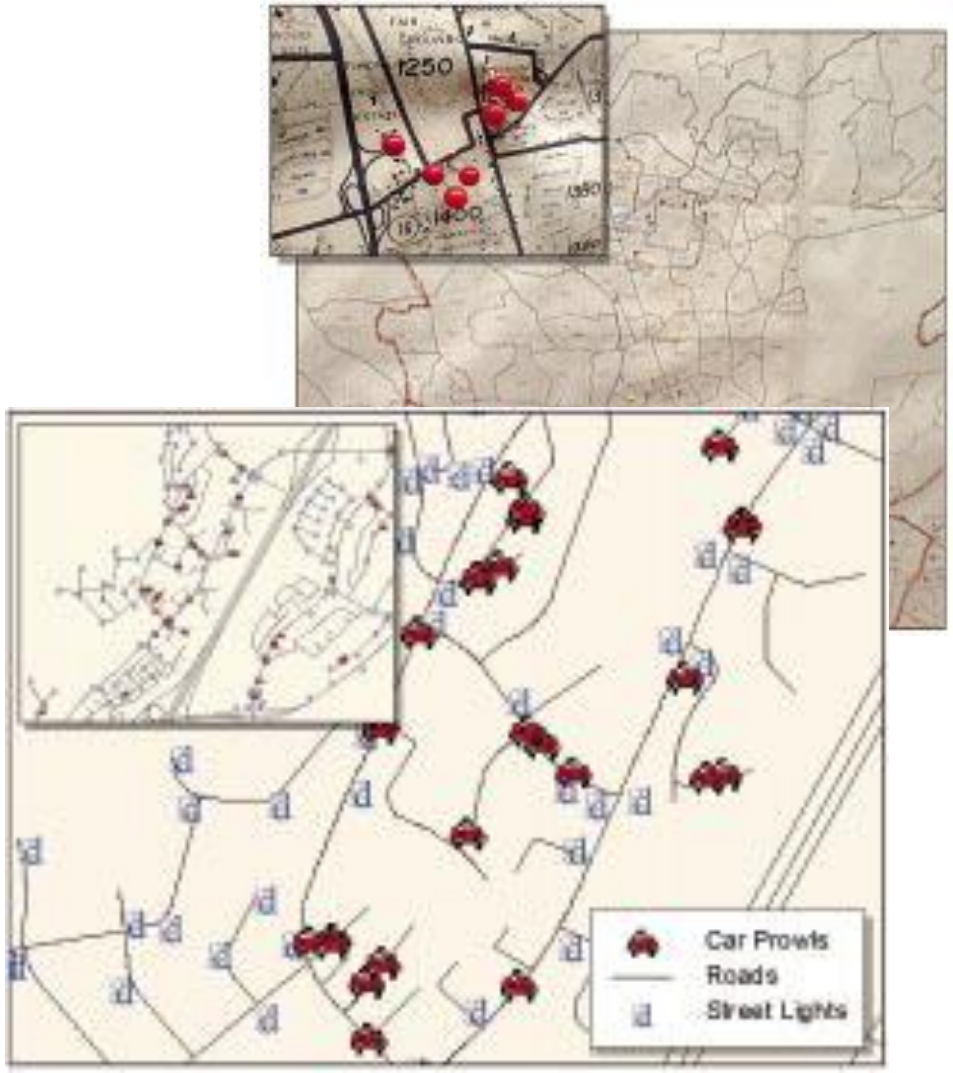
– Equal chance of them happening anywhere at anytime.

But crime is not randomly distributed

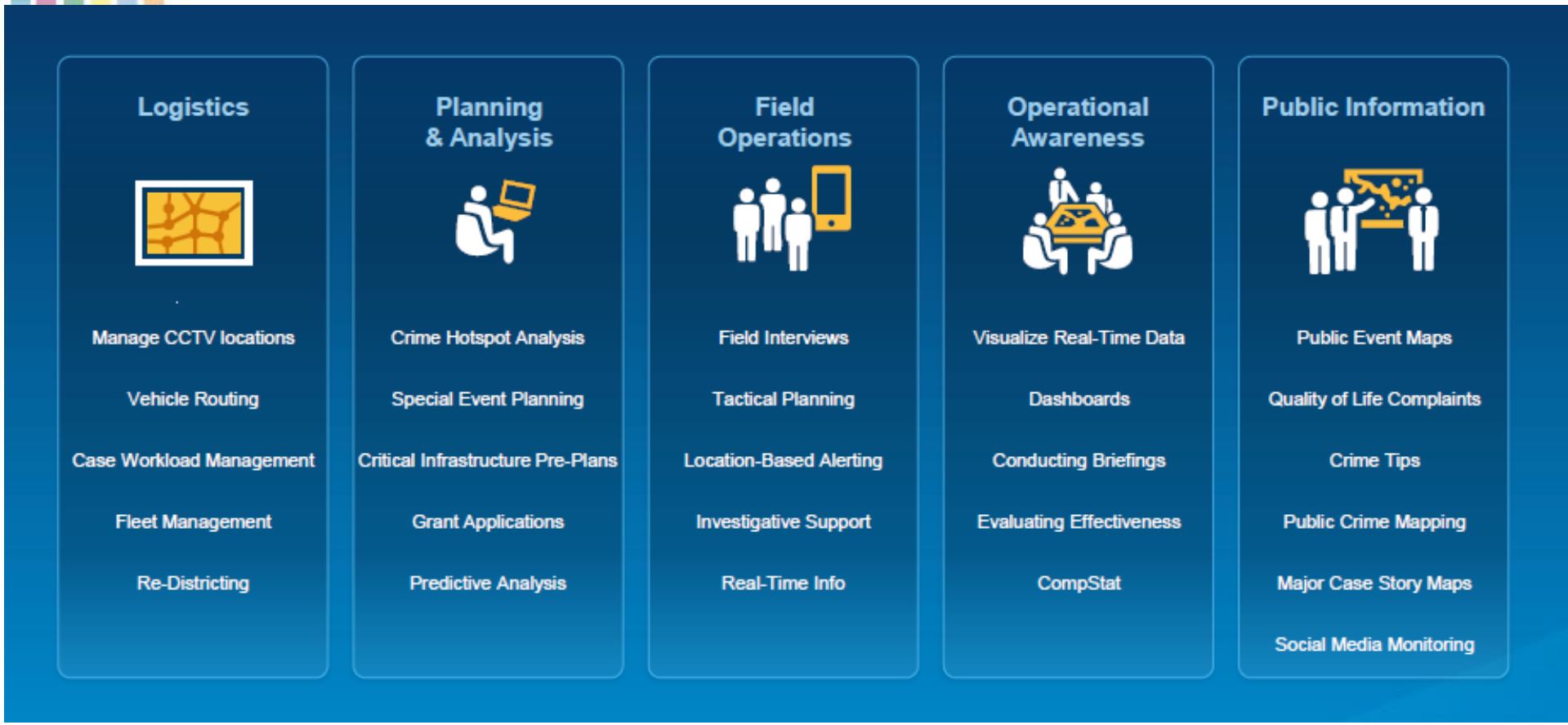
- Concentrated into places of activity
  - Crime hotspots
- Series follow geographic patterns
  - Serious and volume crime

Where it all has begun?

- From pin maps to virtual pin maps.
- Space and time limitations and overlaps.
- Crime typology problems.



Current use of GIS in police practice



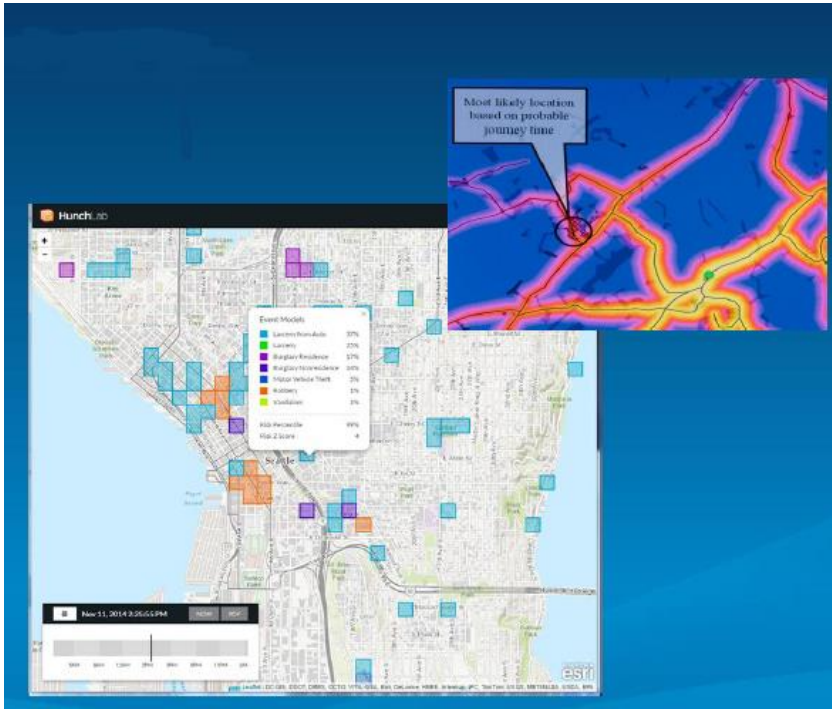
- **Community policing**

Major GIS Trends in Law Enforcement

Predictive Policing

- **Geographic Profiling**
- **Temporal patterns**
- **Weather**
- **Risk-Terrain Modelling**
- **Socioeconomic Indicators**
- **Near-Repeat Patterns**

Descriptive vs. Predictive modelling



Podstata prediktivního modelování

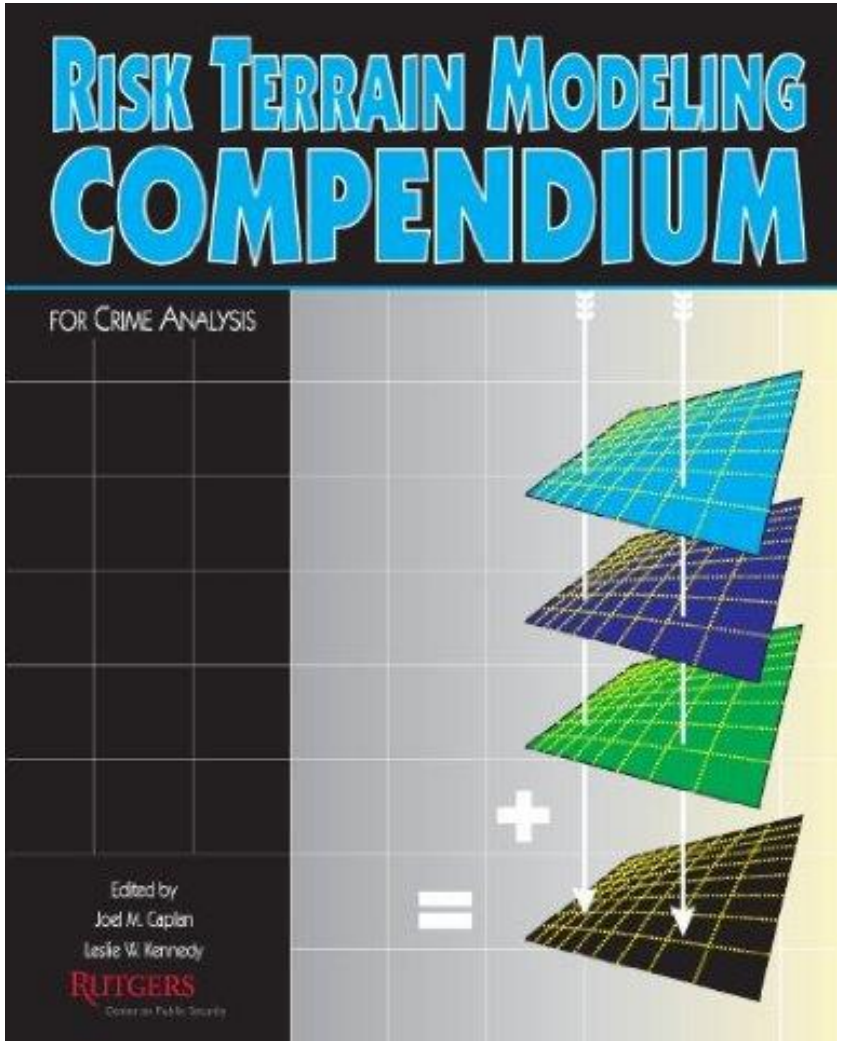
- Doposud jsme se zabývali problémem, jak počítač „vidí" geografická data prostřednictvím popisných (deskriptivních) technik a vytváří z nich oblasti s určitými vlastnostmi.
- Další logický krok je použití „**prediktivních – předpovědních" technik k vytvoření extrapolačních map předvídajících budoucí podmínky**.
- Využití v řadě oblastí:
  - **Predikce kriminality**.

Predictive Crime Analysis

- **WHAT?**
- „Predictive policing in the context of place is the use of **historical data** to create a **spatiotemporal forecast** of **crime hot spots.**
- **WHY?**
- that will be the **basis for police resource allocation** decisions with the expectation that having officers at the proposed place and time **will deter or detect criminal activity**."

Risk Terrain Modeling Prediction

- Risk terrain modeling (RTM) is an **approach to risk assessmen**t in which separate **map layers** representing the influence and intensity of a **crime risk factor** at every place throughout a geography is created in a geographic information system (GIS).
- Map layers are combined to produce a **composite "risk terrain" map** with values that account for all risk factors at every place throughout the geography.
- Available in PDf – ask your lecturer ☺



RTM steps

1. Select an outcome **event** of particular interest
2. Choose a study **area**
3. Choose a time **period**
4. Obtain **base maps** of your study area
5. Identify **aggravating** and **mitigating** factors related to the outcome event
6. **Select** particular **factors** to include in the RTM
7. **Operationalize** the spatial influence of factors to risk map layers
8. **Weight** risk map layers relative to one another
9. **Combine** risk map layers to form a composite map
10. **Finalize** the risk terrain map to **communicate** meaningful and actionable information.

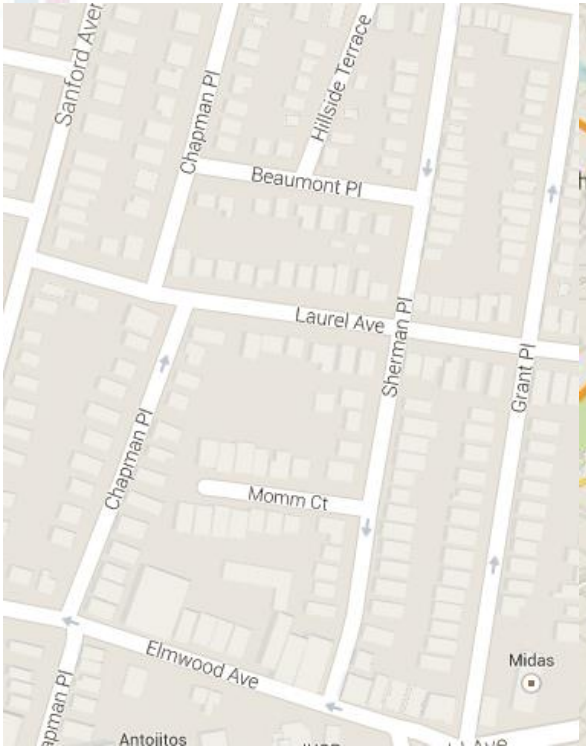
Step 1 -2

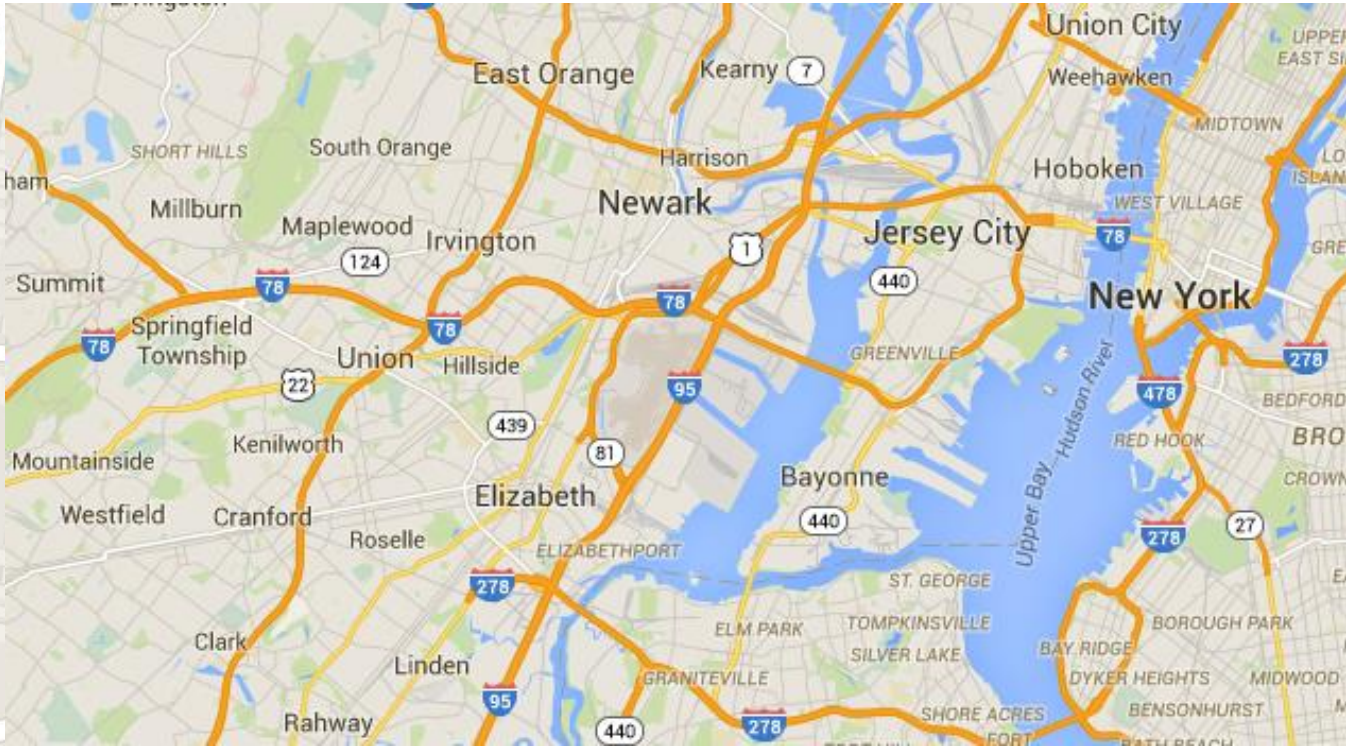
1. Select an outcome **event** of particular interest

Gun shooting incidents.

2. Choose a study **area *on which risk terrain maps will be created.***

The Township of Irvington, NJ.





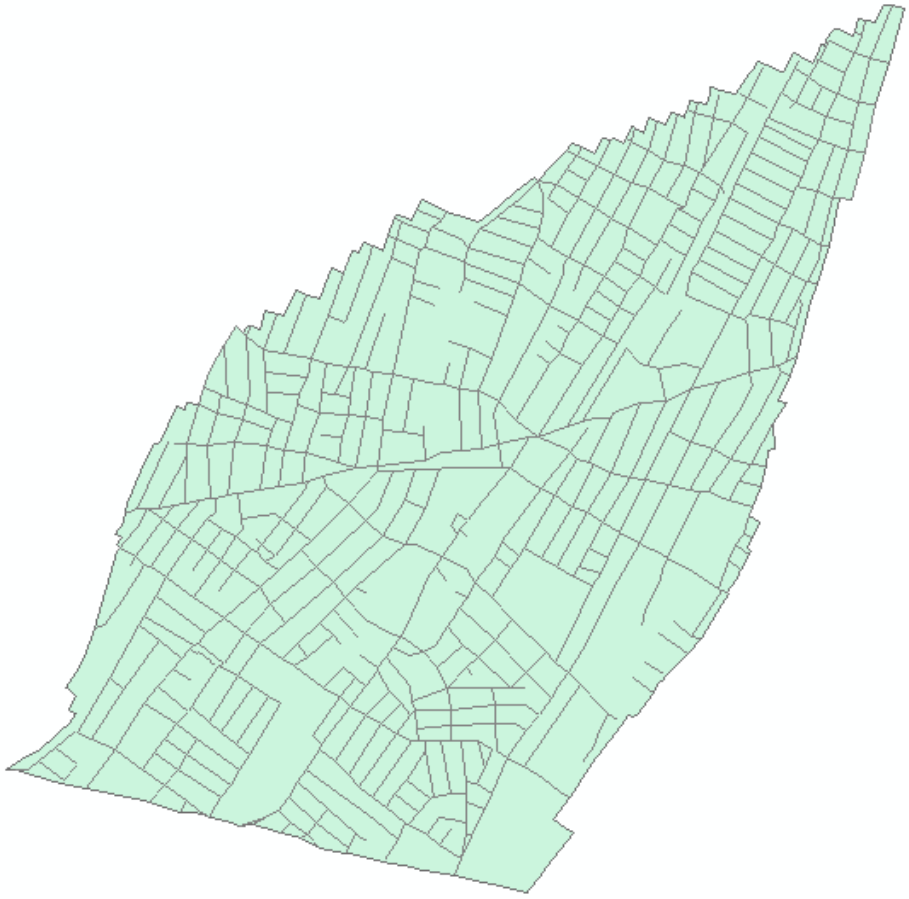
Step 3

STEP 3: Choose a time period to create risk terrain maps for.

- Six month time period: January 1 to June 30.
- It is expected that this time period will adequately assess the place-based risk of shootings during the next 6-month time period (July 1 to December 31).
- **Data availability and comparability ?? Is it really justifiable and valid for the Czech Republic?**

Step 4

- ***STEP 4: Obtain base maps of your study area.***
- Two base maps were obtained from Census 2000 TIGER/Line Shapefiles:
  - 1) Polygon shapefile of the Township and
  - 2) **Street centerline** shapefile for the Township.



Step 5

STEP 5: Identify aggravating and mitigating risk factors that are related to the outcome event.

- Three **aggravating factors** were identified based on a ***review of empirical literature***:
  - dwellings of known gang members (**habitual offenders**),
  - locations of **retail business infrastructure (**bars, strip clubs, bus stops, check cashing outlets, pawn shops, fast food restaurants, and liquor stores),
  - locations of **drug arrests** (places, where the police action happened).

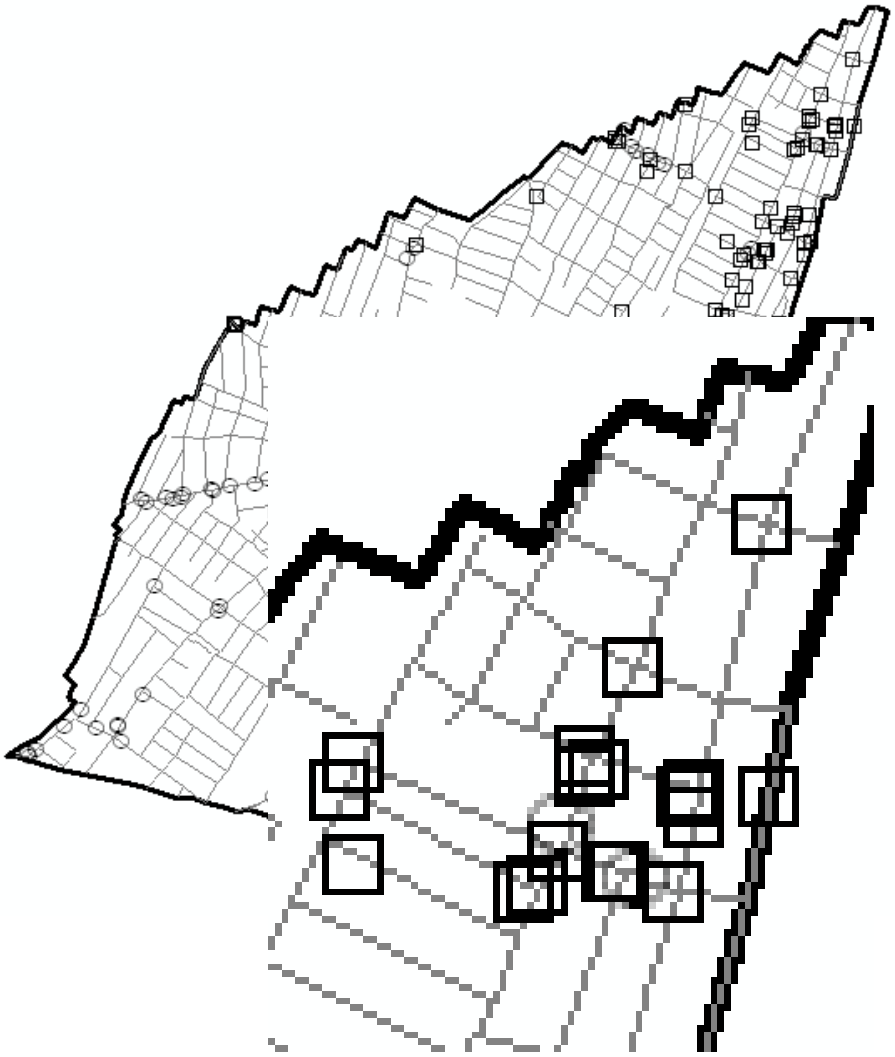
Step 6

- ***STEP 6: Select particular risk factors to include in the risk terrain model.***
- All three risk factors identified in Step 5 will be included.
- Raw data in tabular form (i.e. Excel spreadsheets) was provided by the Township police and the many **datasets they maintain, validate and update regularly to support internal crime analysis and police investigations**.
- Attributes + **addresses** + time stamps + ??
- **State of the art of the investigation including the punishment and legal procedure.**

- ***STEP 7: Operationalize risk factors to risk map layers.***
- The tabular data was geocoded to street centerlines of Irvington to create point features representing:
  - the locations of gang members' **residences** (hiden on the map to protect the gang members),
  - retail **business outlets**,
  - and **drug arrests**,

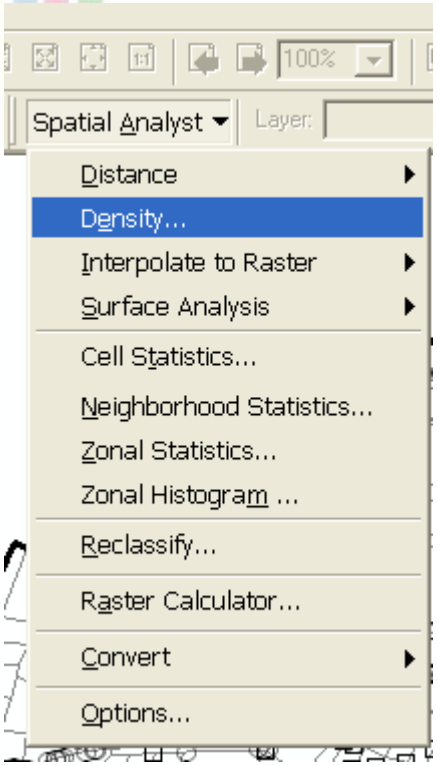
  respectively as three separate map layers.

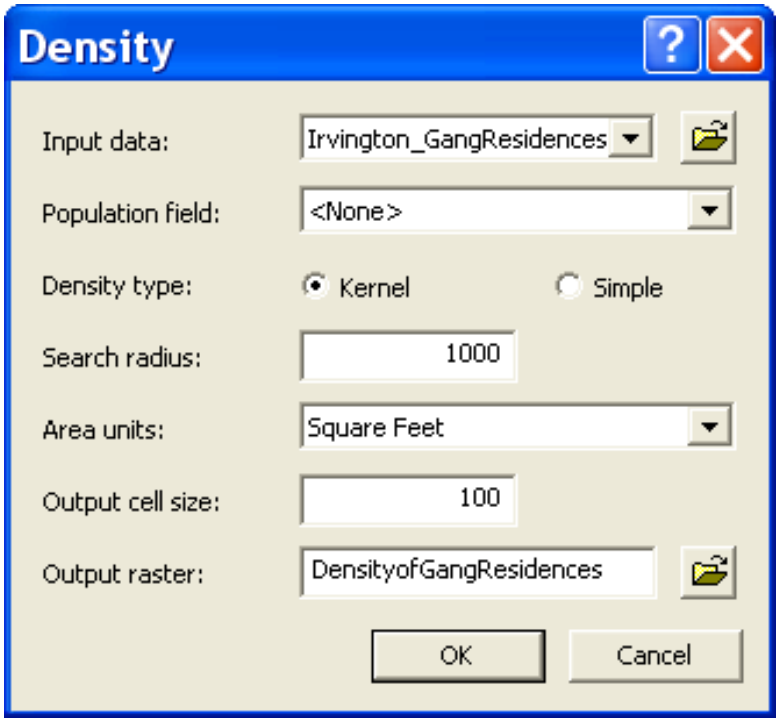
Step 7

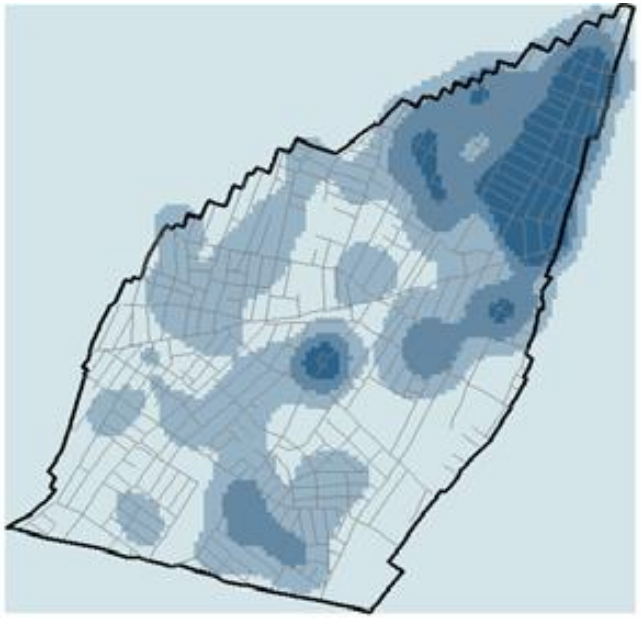


Step 7a – gang member residence

The spatial influence of the "gang members' residences" risk factor was operationalized as: "Areas with **greater concentrations of gang members residing will increase the risk of those places having shootings**." So, a **density map** was created from the points of gang members' residences.

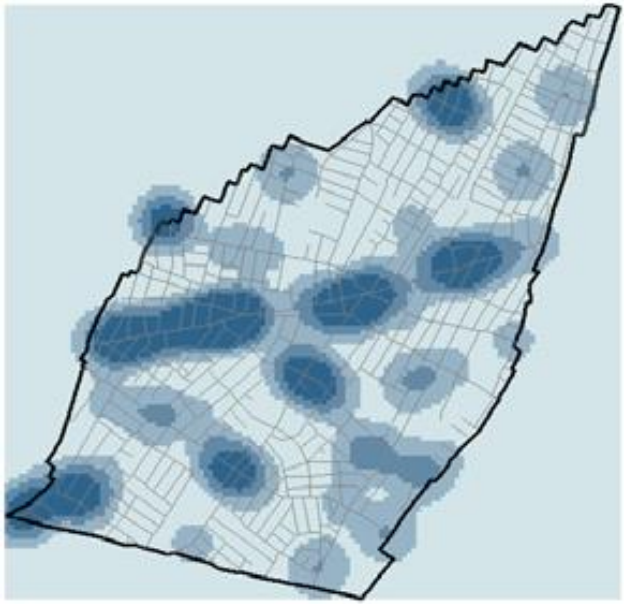






Step 7b - infrastructure

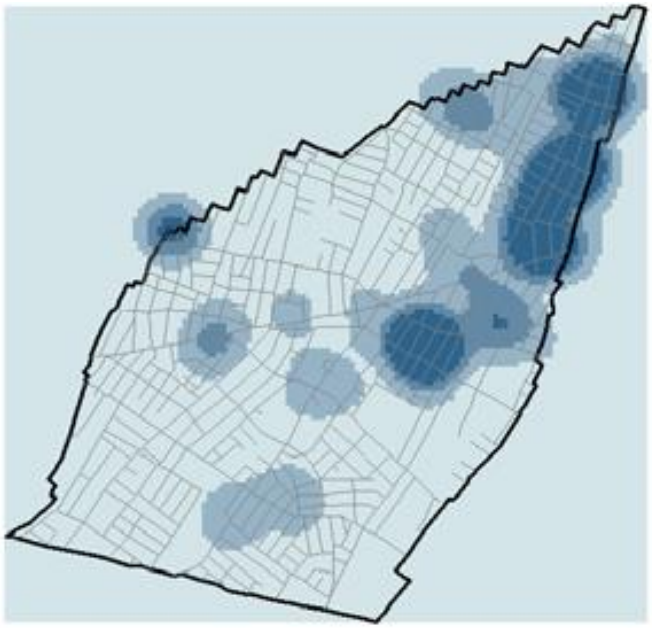
- The spatial influence of the "infrastructure" risk factor was operationalized as:
- "**High concentrations** of bars, strip clubs, bus stops, check cashing outlets, pawn shops, fast food restaurants, and liquor stores **will increase the risk** of those dense places having shootings."



Step 7C – the drug arrest

the “drug arrest” risk factor was operationalized as:

- “Areas with **high concentrations** of drug arrests **will be at a greater risk for shootings** because these arrests create new ‘open turf’ that other drug dealers fight over to control.“



Step 7 – map density method details

- **Kernel density** values were calculated for each of the risk map layers so that *points lying near the center of a cell's search area would be weighted more heavily than those lying near the edge*, in effect smoothing the distribution of values.
- Cells within each density map layer were **classified into four groups according to standard deviational breaks**. The dark blue colored cells had values in the **top five percent** of the distribution and were considered the "**highest risk**" places.

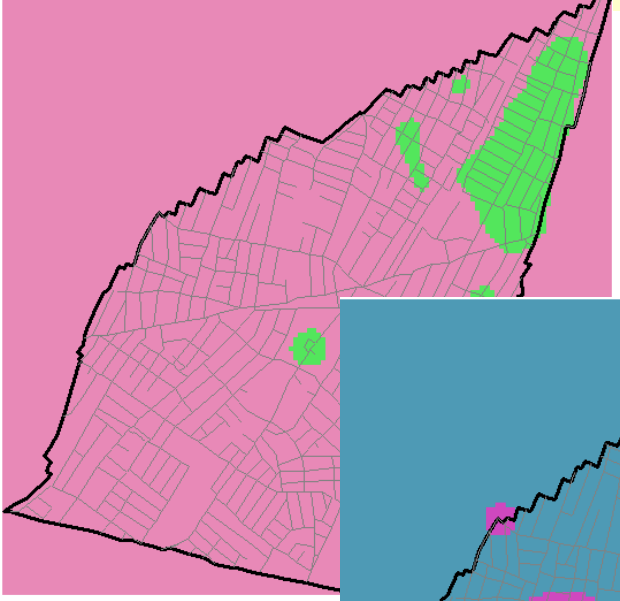
Step 7d – distance from infrastructure

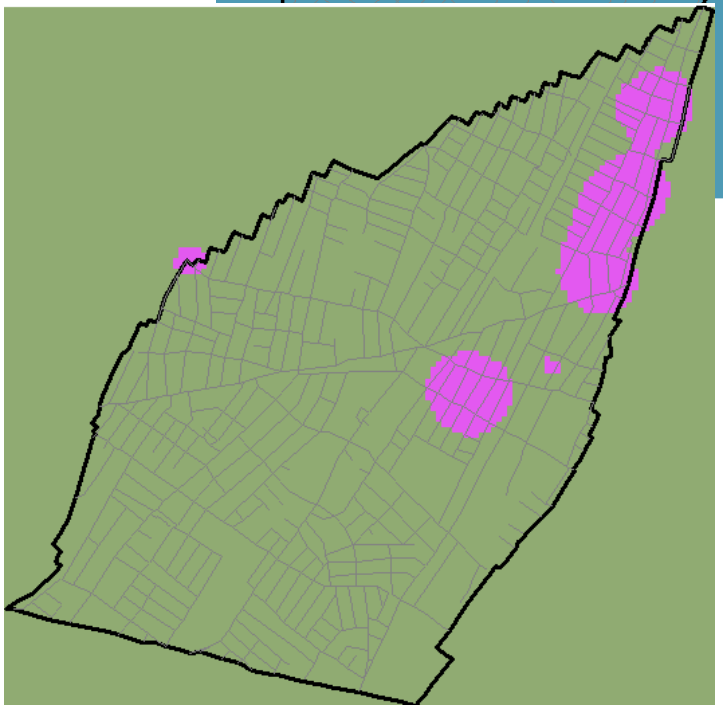
- The spatial influence of the "infrastructure" risk factor was also operationalized as:
- "The **distance of one block**, or about 350ft (app. 100 m), from a facility poses the greatest risk of shootings because **victims** are often **targeted** when **arriving** at or **leaving** the establishment."

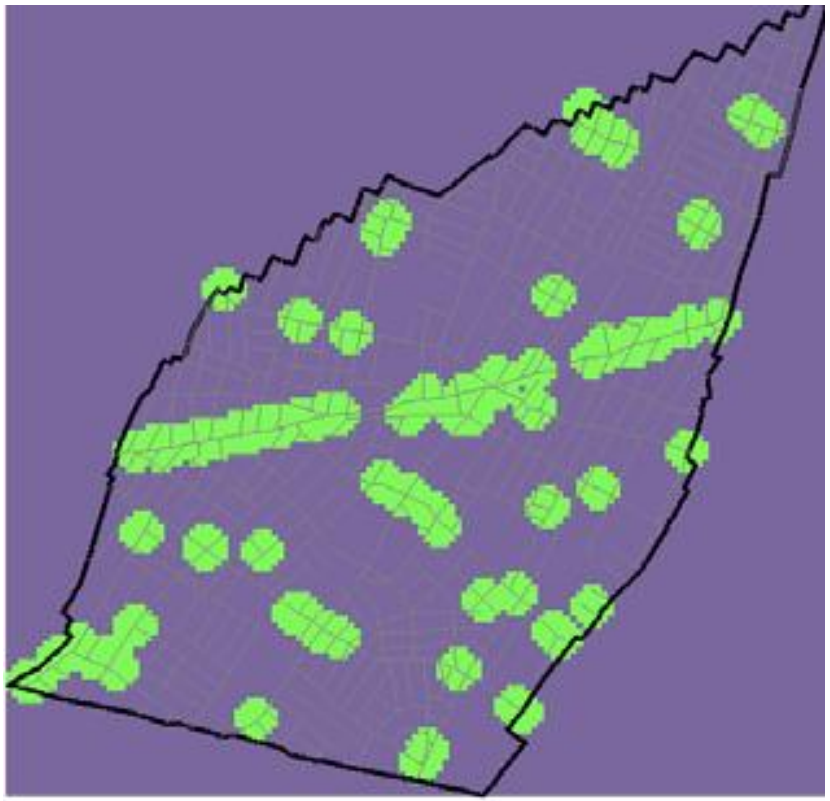
7e – final operationalization

- **We** are only interested in knowing where places are the most at risk for shootings, so we used a **binary-valued schema** to designate the "**highest risk**" places across all four risk map layers.
- The highest risk places of each risk map layer, respectively, will be given a value of "1"; all other places will be given a value of "0".
- All risk factors are operationalized as **aggravating factors**, so these values will **remain positive**.

Step 7 - reclassification

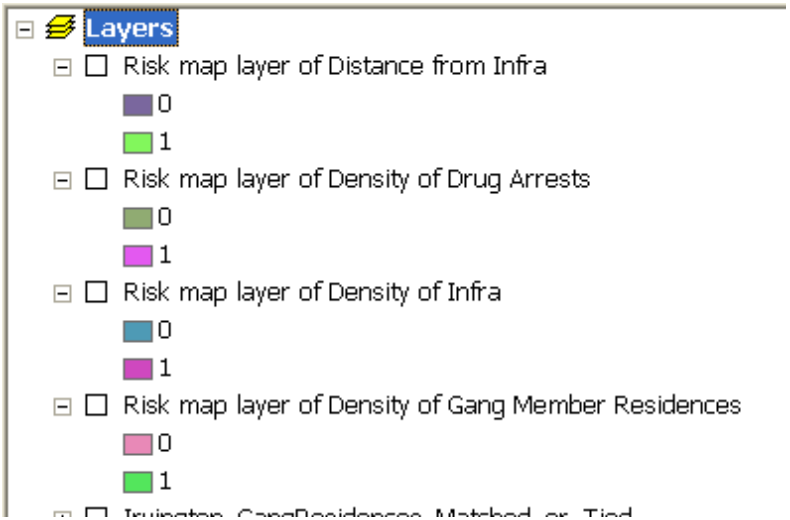






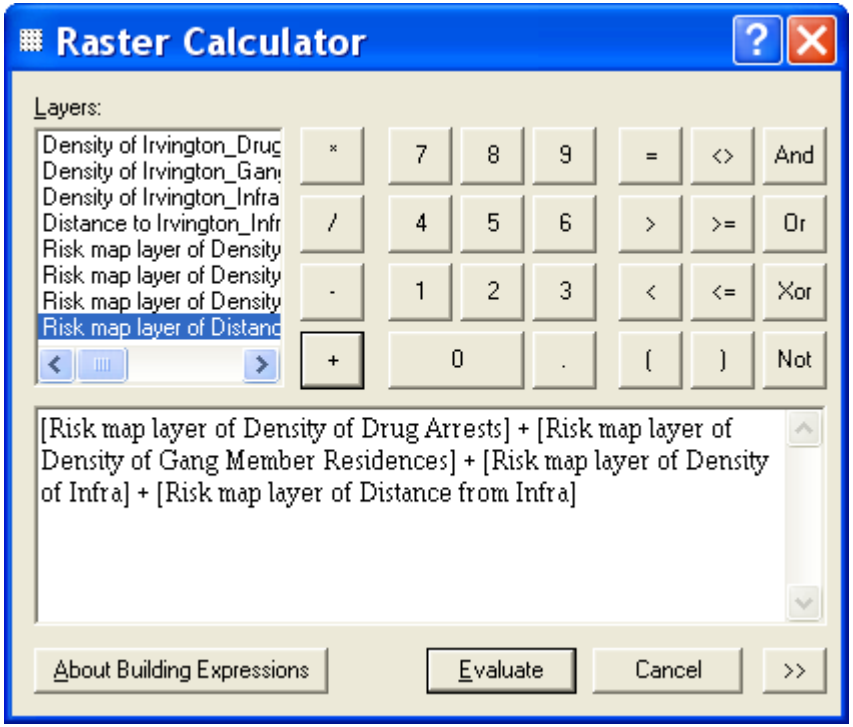
Step 7 – final comparison

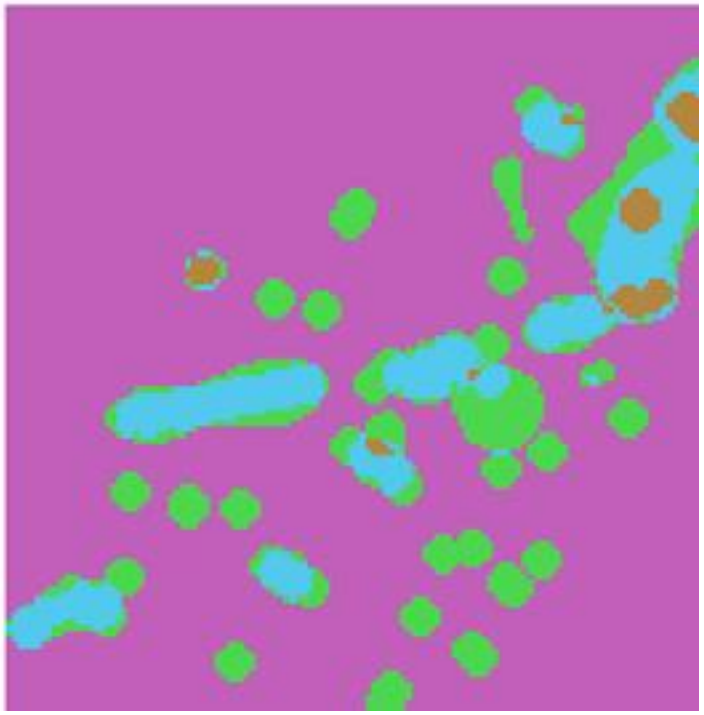
- We now have **four (final) risk map layers, operationalized from three risk factors.**
- **Binary** reclassification – 0 – 1
- The cells of different map layers are the same size and were classified in a standad way, the risk **map layers can be summed together** to form a **composite risk terrain map**.



Step 8 + 9 - *Inter Risk Map Layer Weighting and CRTM*

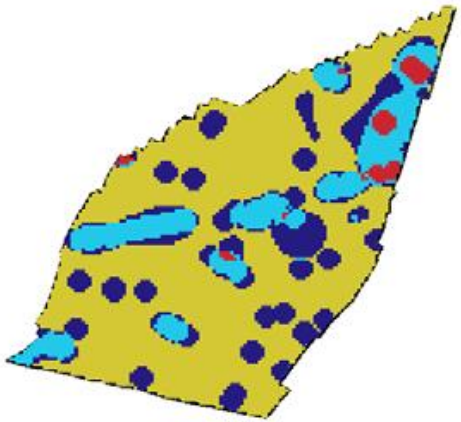
All risk **map layers** will carry equal weights to produce an **un-weighted risk terrain model.** It is assumed, for example, that being in a place with a high concentration of drug arrests **poses the same risk** of having a shooting as being in a place with a high concentration of gang member residences. Unless we know better ☺ !!



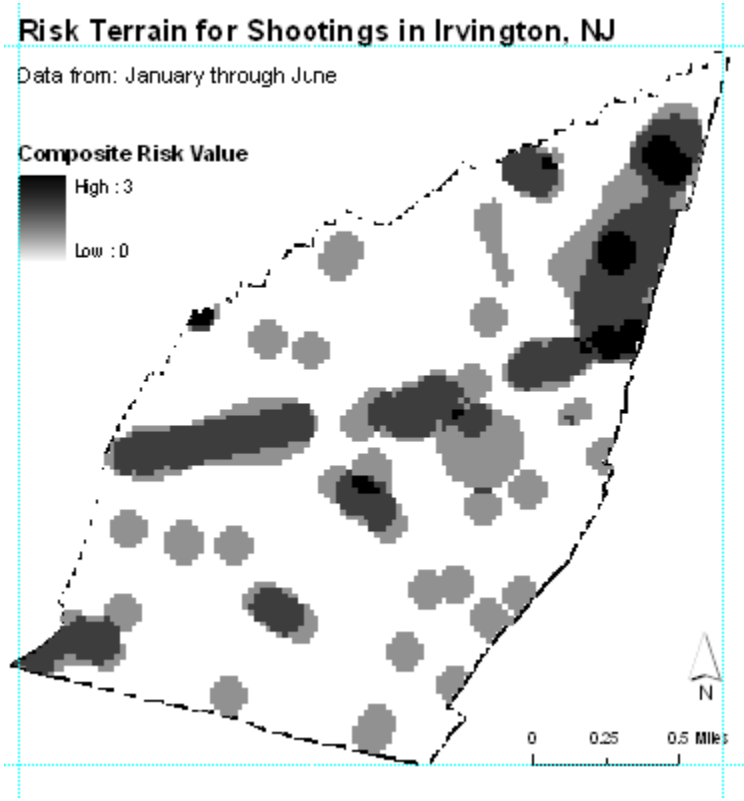


STEP 10 - Finalize the Risk Terrain Map to Communicate Meaningful Information.

- Clip our risk terrain map to the boundary of Irvington.



- produce a final map with shades of grey and layout.

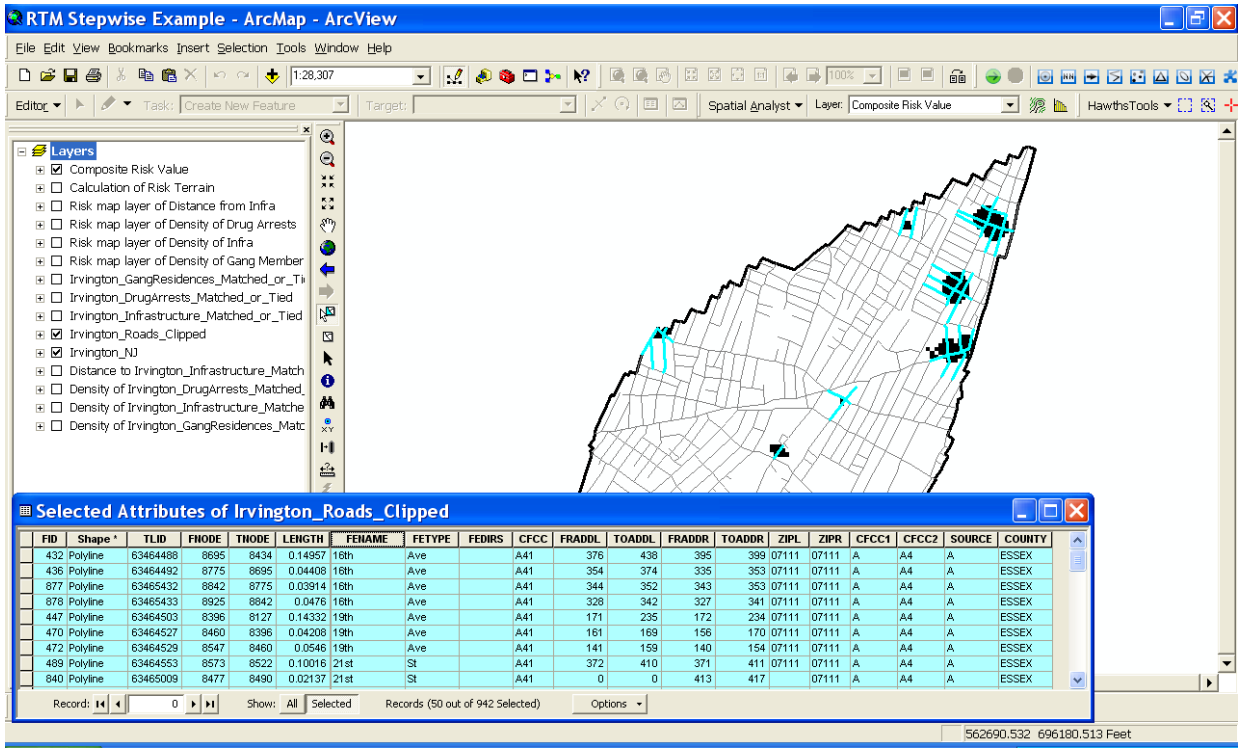


Step 10 – make the risk count

- convert the risk terrain map from raster to vector we can (still using the regular structure converted to square polygons):
- **count the number of shootings that actually occur in the high-risk areas during the subsequent time period**;
- calculate the **square area** of the highest risk areas (i.e., places with a composite risk value of 3);

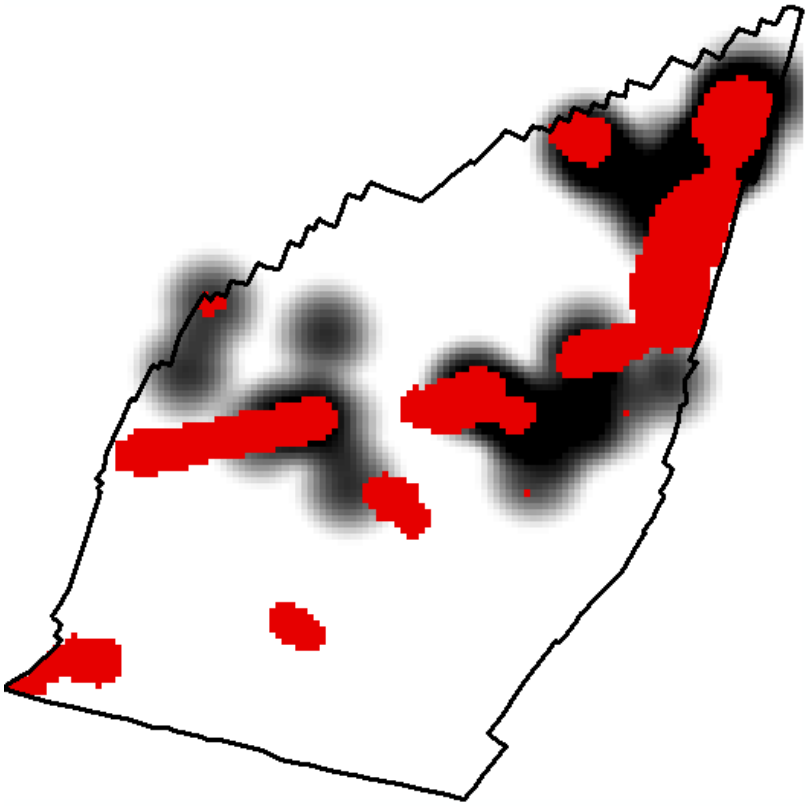
Step 10 – make the risk count

- Select all street segments within these areas to inform police commanders about where patrols might be increased.
- Operationalise the command and controll on the day by day basis.



RTM validation

- **Comparison with the subsequent time period (June 1 – December 31) – high risk RTM classes and hot spot analysis of actual shooting accidents.**
- About 50% (15 out of 31) of the shootings during the subsequent time period (July 1 to December 31) happened in these high-risk cluster areas.



Things to remeber

- **Remember**, risk terrain modeling is only a *tool for spatial risk assessmen*t; it is not the solution to crime problems.
- You (the analyst) give **value and meaning to RTM**, so be innovative in your thinking about risk factors and how risk terrain maps can be applied to police operations.

Risk Terrain Modelling