# The Crime Prediction Framework:

## a spatial temporal framework for targeting patrols, crime prevention and strategic policy

***National Security Summit, San Diego 18 July 2015***

Dr Spencer Chainey twitter @SpencerChainey

Department of Security and Crime Science, University College London

# Outline

- Reducing crime and improving public safety
- The Crime Prediction Framework
  - The *future*: immediate, near and distant
  - Aligning predictions to service responses
  - Crime prediction and its sensitivity to spatial-temporal patterns of crime and the retrospective volume of crime data

- Introduce a methodical framework for predicting crime and how this should then inform how you go about responding to crime

## It is not the sole responsibility of the police/law enforcement to reduce crime and improve public safety

- Properly understanding crime involves linking with local partners
- Need to identify specific role that partners should play (particularly in austere times)

# Good policing and effective crime reduction

## Involves three types of service response …

1. **Immediate, operational response**: for example, targeting of police resources on the next patrol shift

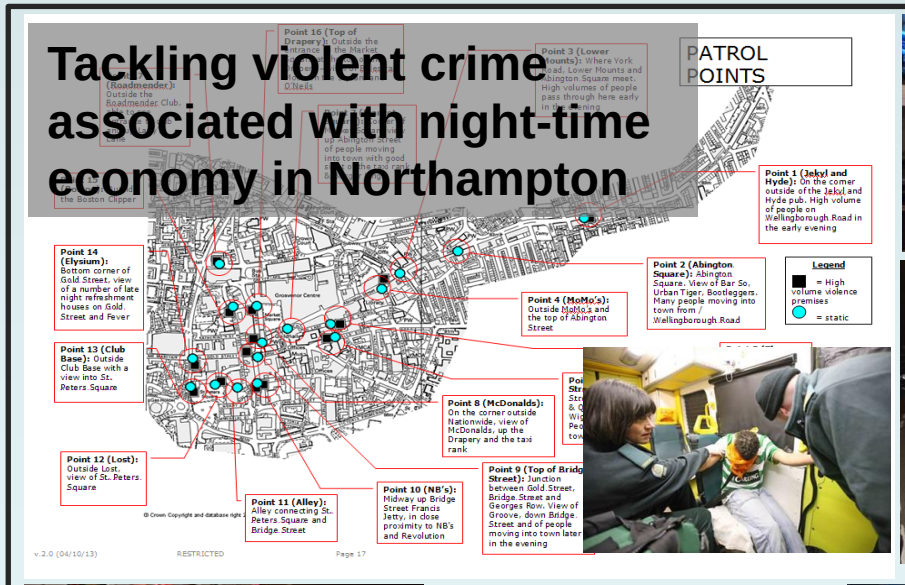


# Good policing and effective crime reduction

## Involves three types of service response …

2. **Medium-term, situational response:** for example, working with other local agencies to remove opportunities for committing crime

**Tackling violent crime associated with night-time economy in Northampton**









**Reducing motorbike theft in London**

# Good policing and effective crime reduction

## Involves three types of service response …

3. **Long-term, strategic response:** for example, addressing endemic causes through regeneration schemes, strategy, and changes in policy

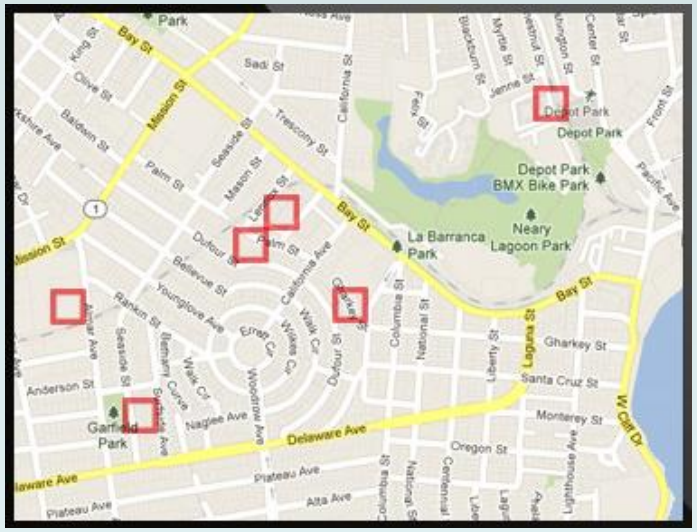
**Before: chaotic, insecure storage, high theft**


**After: organised storage, more secure, low theft**

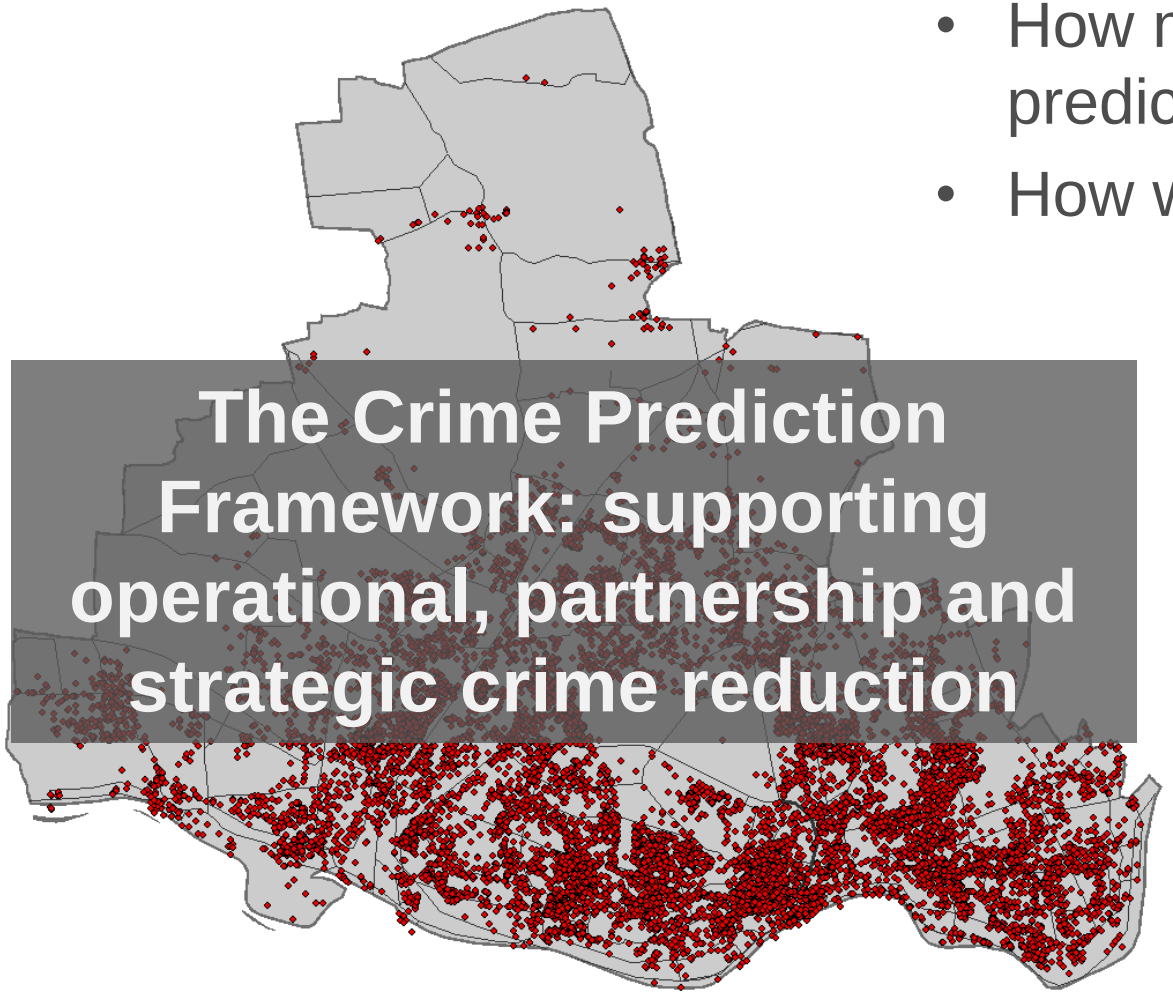
# Predictive mapping techniques and data

## Shows where … but weaker in informing when, why, and what to do when there

- **When?** lack of consideration given to what is meant by ***the future*** – the next few hours, days, weeks?
  - Predictions for different timeframes require different types of service response
- **Why?** if spatial predictions of crime are to be made with confidence, the prediction must be based on clear theoretical principles (i.e., the prediction can be explained)
  - Which in turn informs the type of response and who is best placed to respond
- **Data and techniques:** little consideration given to whether different retrospective periods of crime data and different techniques/models provide different predictions




# A year of crime in Newcastle (October 2013 to September 2014, n = 24,259)



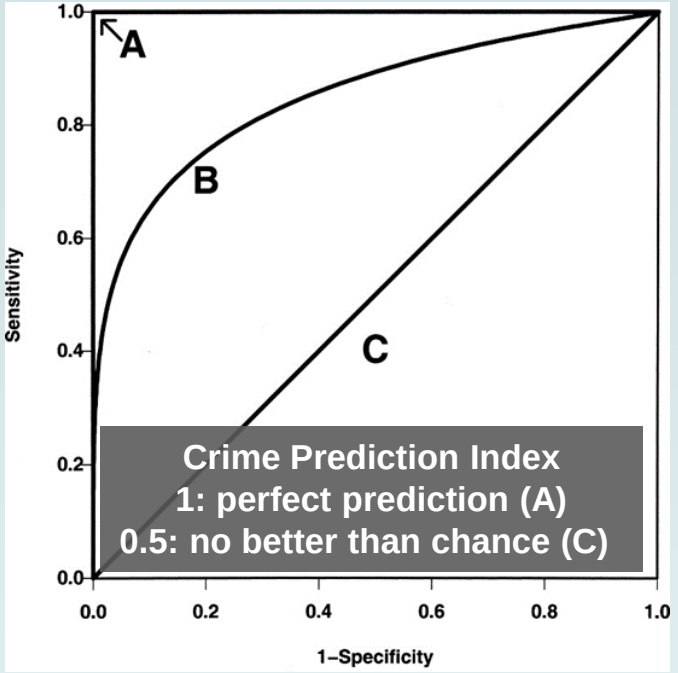
**The Crime Prediction Framework: supporting operational, partnership and strategic crime reduction**

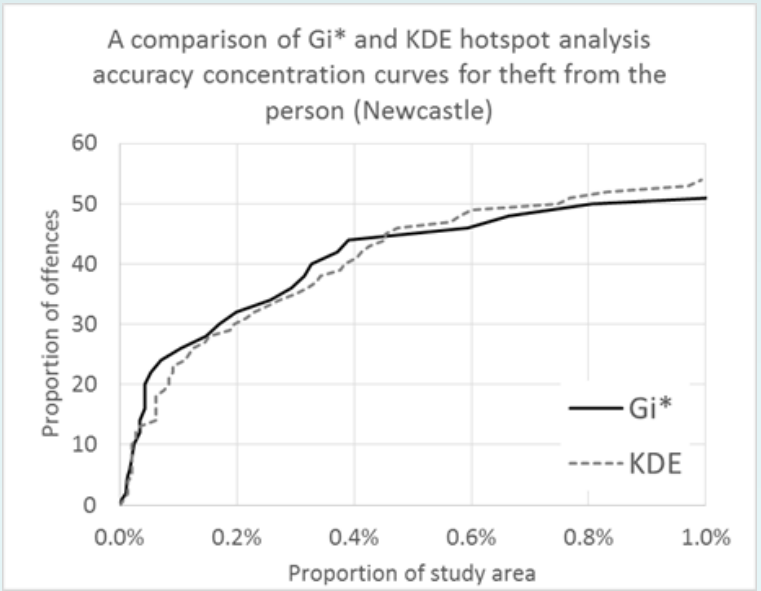
- How many of these crimes could have been predicted?
- How would they have been prevented?

# Spatial crime prediction – the research

## Seven year research study into spatial prediction of crime

- Development of rigorous statistical methods for measuring prediction performance
  - Accuracy concentration curves (ROC curves)
  - Crime Prediction Index (area under the curve)
- Prediction performance of spatial analysis techniques applied to crime data
  - Repeat victimisation, near repeat victimisation, hotspot analysis, spatial regression
- Extent to which recent and historical crime informs future crime
- Temporal stability of hotspots
- Within the context of 20 years of practical experience of policing and public safety

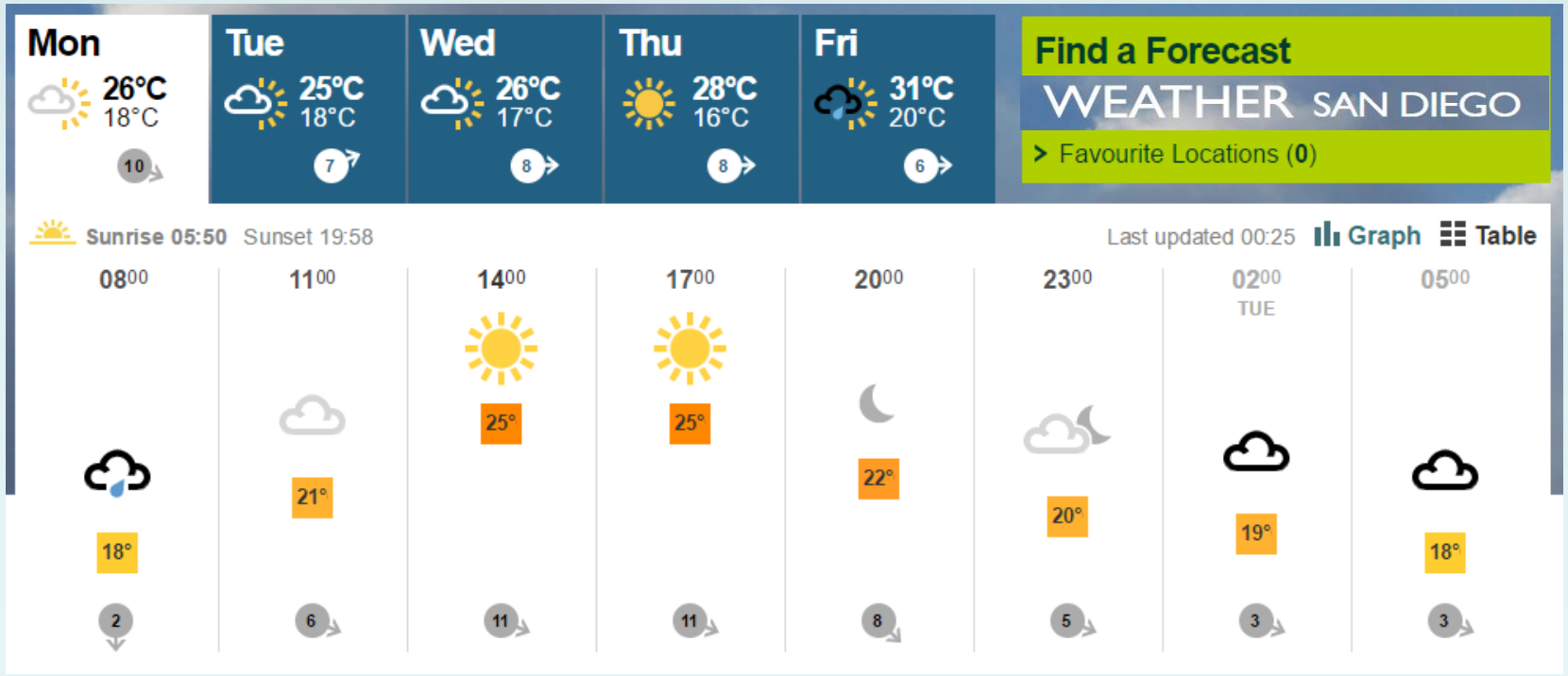


# An analogy: weather forecasting

## Forecasting the next few days

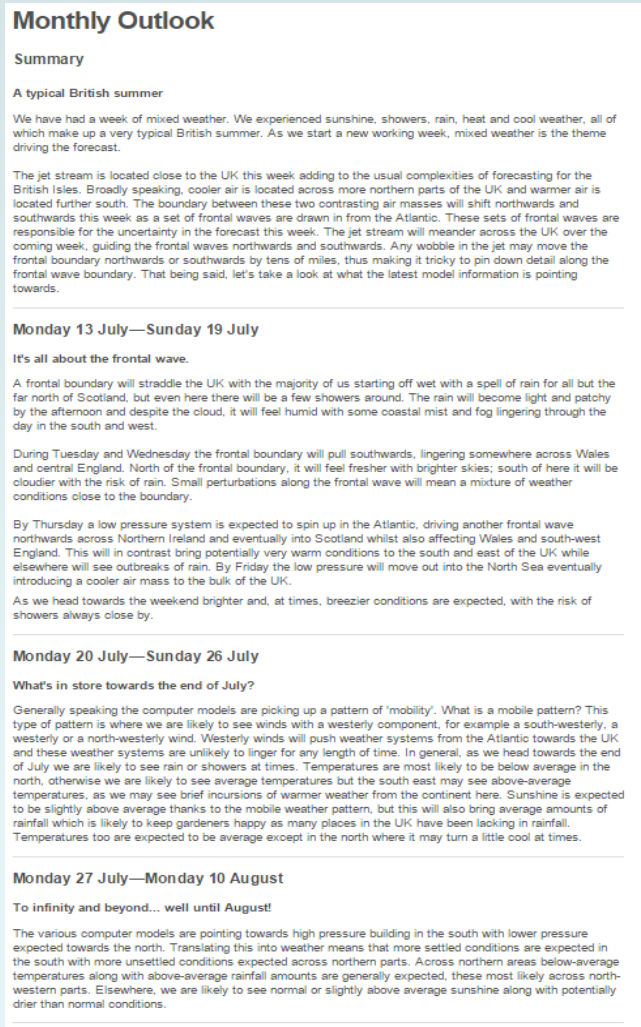
- Data: recent weather best predictor of the immediate future
- Forecasting technique that draws on current known patterns of weather e.g., movement of weather fronts, rainfall radar, movement of high pressure systems



# An analogy: weather forecasting

## Forecasting the next week/month

- Data: recent and historical weather patterns
- Forecasting technique: models that combine recent weather patterns with upper atmosphere weather movements, and seasonal patterns

**Monthly Outlook**

**Summary**

**A typical British summer**

We have had a week of mixed weather. We experienced sunshine, showers, rain, heat and cool weather, all of which make up a very typical British summer. As we start a new working week, mixed weather is the theme driving the forecast.

The jet stream is located close to the UK this week adding to the usual complexities of forecasting for the British Isles. Broadly speaking, cooler air is located across more northern parts of the UK and warmer air is located further south. The boundary between these two contrasting air masses will shift northwards and southwards this week as a set of frontal waves are drawn in from the Atlantic. These sets of frontal waves are responsible for the uncertainty in the forecast this week. The jet stream will meander across the UK over the coming week, guiding the frontal waves northwards and southwards. Any wobble in the jet may move the frontal boundary northwards or southwards by tens of miles, thus making it tricky to pin down detail along the frontal wave boundary. That being said, let's take a look at what the latest model information is pointing towards.

**Monday 13 July—Sunday 19 July**

**It's all about the frontal wave.**

A frontal boundary will straddle the UK with the majority of us starting off wet with a spell of rain for all but the far north of Scotland, but even here there will be a few showers around. The rain will become light and patchy by the afternoon and despite the cloud, it will feel humid with some coastal mist and fog lingering through the day in the south and west.

During Tuesday and Wednesday the frontal boundary will pull southwards, lingering somewhere across Wales and central England. North of the frontal boundary, it will feel fresher with brighter skies; south of here it will be cloudier with the risk of rain. Small perturbations along the frontal wave will mean a mixture of weather conditions close to the boundary.

By Thursday a low pressure system is expected to spin up in the Atlantic, driving another frontal wave northwards across Northern Ireland and eventually into Scotland whilst also affecting Wales and south-west England. This will in contrast bring potentially very warm conditions to the south and east of the UK while elsewhere will see outbreaks of rain. By Friday the low pressure will move out into the North Sea eventually introducing a cooler air mass to the bulk of the UK.

As we head towards the weekend brighter and, at times, breezier conditions are expected, with the risk of showers always close by.

**Monday 20 July—Sunday 26 July**

**What's in store towards the end of July?**

Generally speaking the computer models are picking up a pattern of 'mobility'. What is a mobile pattern? This type of pattern is where we are likely to see winds with a westerly component, for example a south-westerly, a westerly or a north-westerly wind. Westerly winds will push weather systems from the Atlantic towards the UK and these weather systems are unlikely to linger for any length of time. In general, as we head towards the end of July we are likely to see rain or showers at times. Temperatures are most likely to be below average in the north, otherwise we are likely to see average temperatures but the south east may see above-average temperatures, as we may see brief incursions of warmer weather from the continent here. Sunshine is expected to be slightly above average thanks to the mobile weather pattern, but this will also bring average amounts of rainfall which is likely to keep gardeners happy as many places in the UK have been lacking in rainfall. Temperatures too are expected to be average except in the north where it may turn a little cool at times.

**Monday 27 July—Monday 10 August**

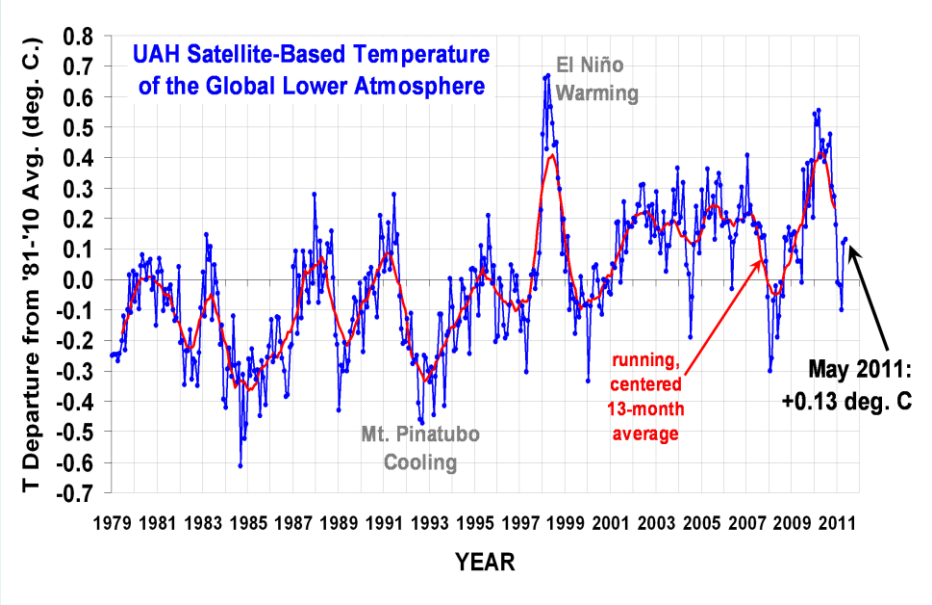
**To infinity and beyond... well until August!**

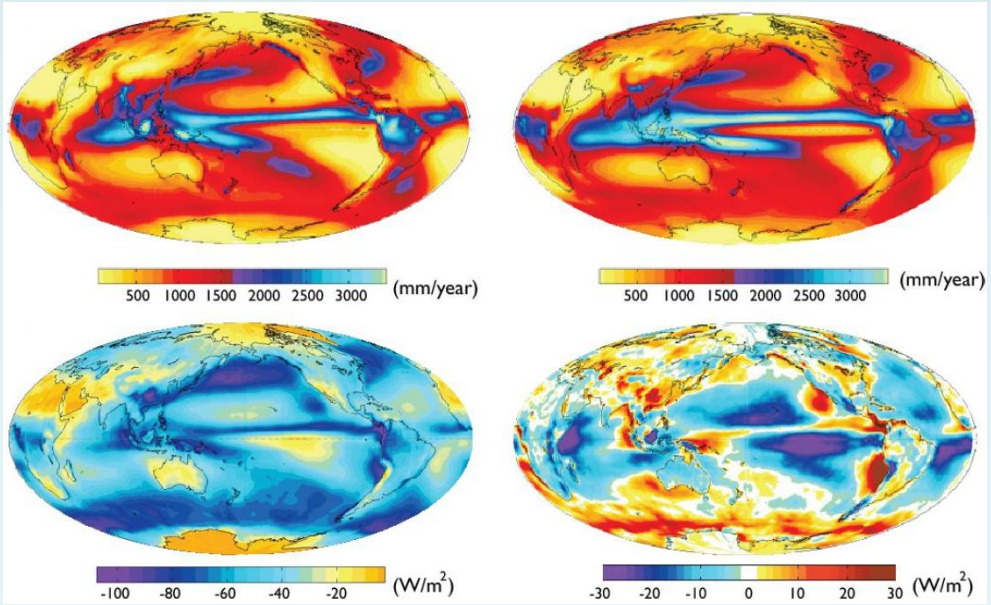
The various computer models are pointing towards high pressure building in the south with lower pressure expected towards the north. Translating this into weather means that more settled conditions are expected in the south with more unsettled conditions expected across northern parts. Across northern areas below-average temperatures along with above-average rainfall amounts are generally expected, these most likely across north-western parts. Elsewhere, we are likely to see normal or slightly above average sunshine along with potentially drier than normal conditions.

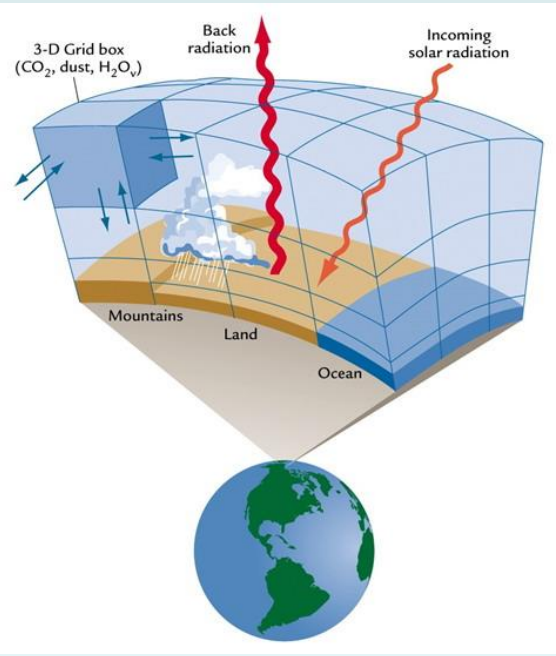
# An analogy: weather forecasting

## Forecasting the next few months and beyond

- Data: historical and cyclical weather events (e.g., El Nino), and other non-weather sources such as sea temperature, greenhouse gases
- Forecasting technique: models that examine the relationship between variables that influence changes in climate



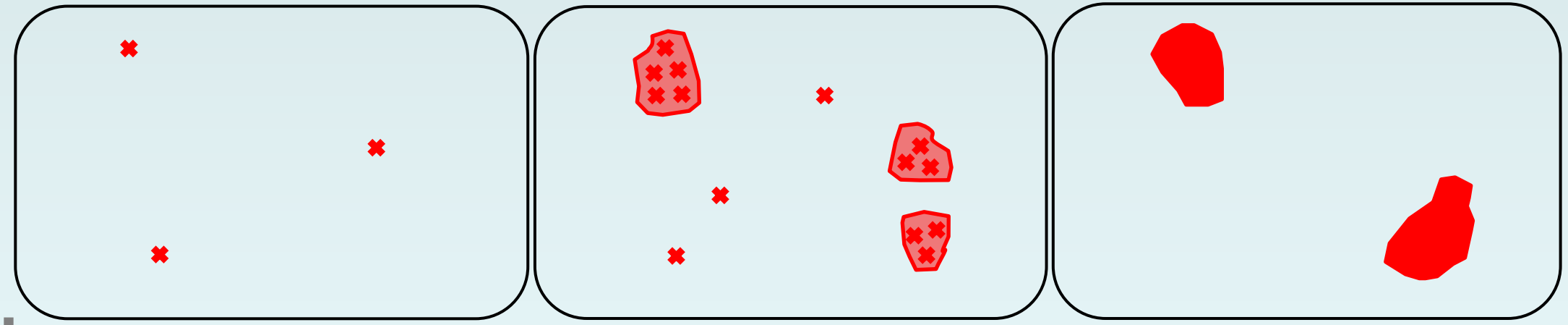



# Predictions aligned to service responses


Police/Law Enforcement

Crime prevention initiatives


Strategies and changes in policy

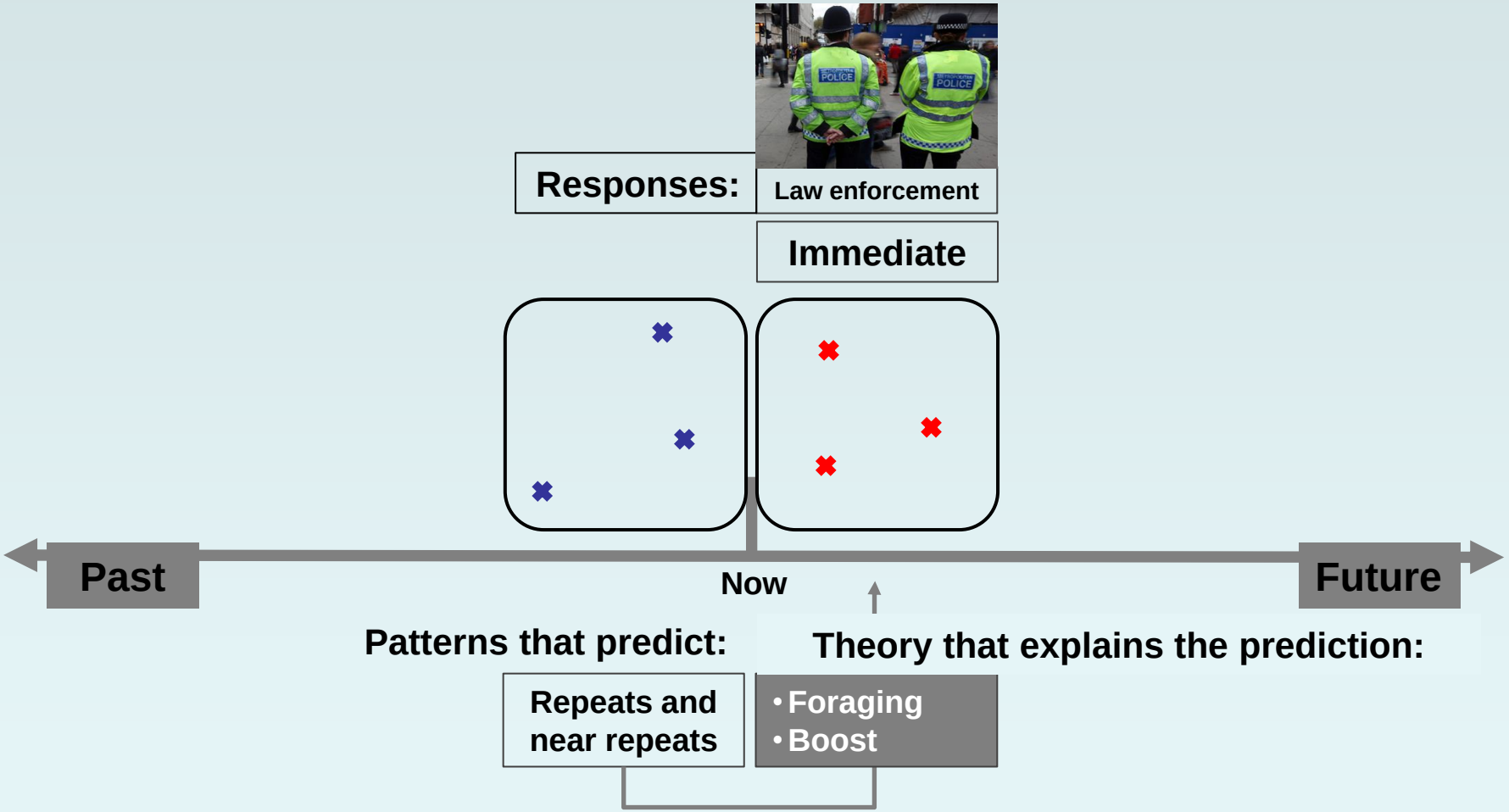


Now → Immediate → Near → Distant → Future

| Appear random | Hotspots | Persistent hotspots |
|---|---|---|
| Spatial patterns | | |

# Predicting the immediate future

## The Crime Prediction Framework



# Predicting the immediate future

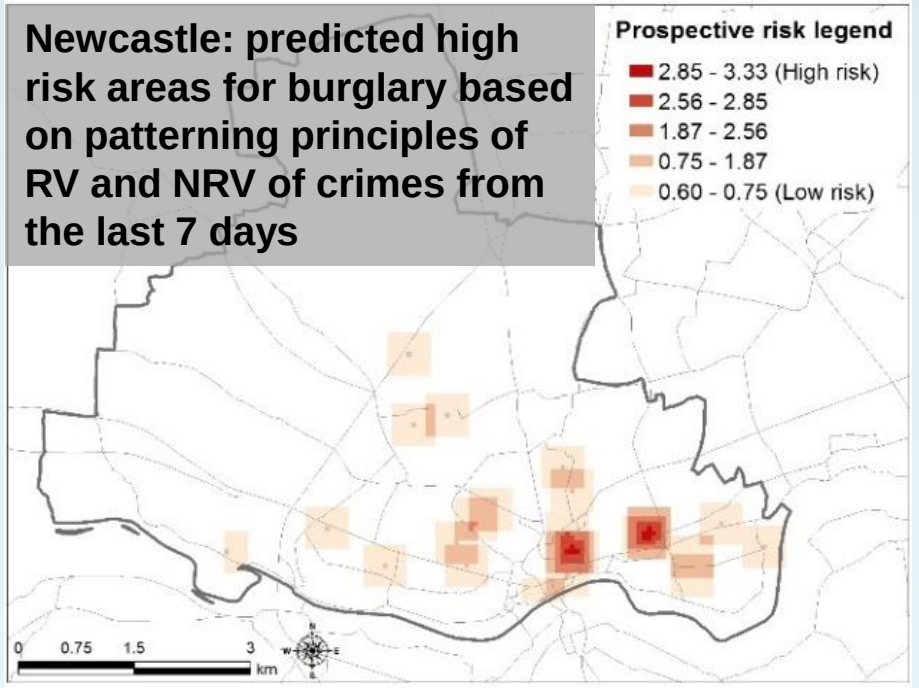
## Patterns that predict: repeat and near repeat victimisation

- The patterning of repeats and near repeats are considered to be the most powerful variables for predicting the immediate future
- Repeat victimisation:

  Heightened risk (and temporal decay of this risk) after an initial victimisation
  - **Newcastle (UK): 15% of all burglaries** (2010)
  - **South Auckland (NZ) 10% of all burglaries** (2014)
- Near repeat victimisation:

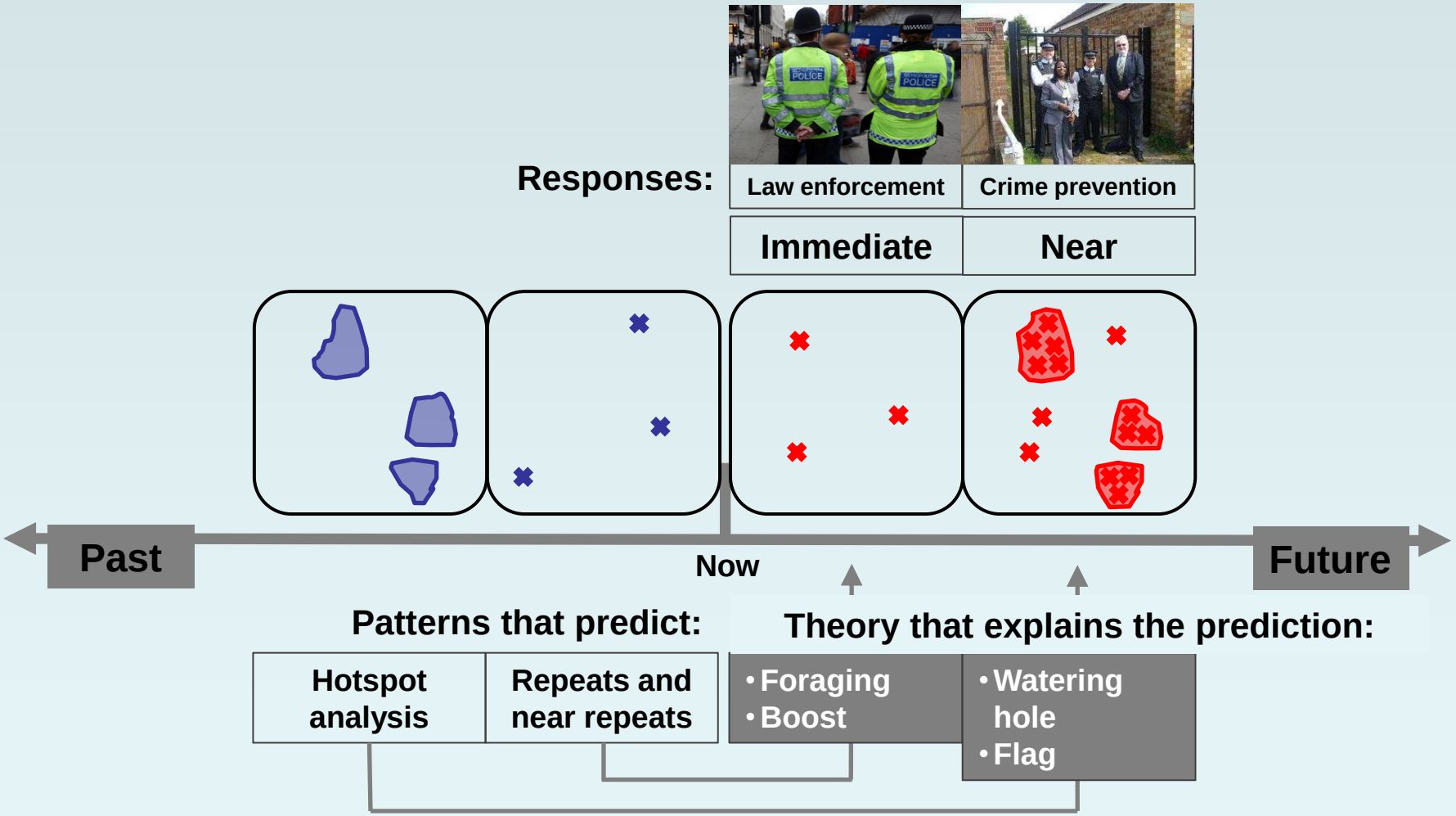
  Heightened risk within short space/time of *originator* incident

  *Within 7 days and 200m of originator incident:*
  - **Newcastle: 23% of all burglaries** (2010)
  - **South Auckland: 15% of all burglaries** (2014)

# Predicting the near future

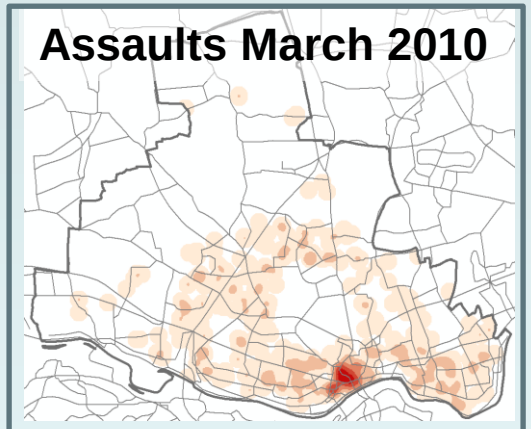
## The Crime Prediction Framework

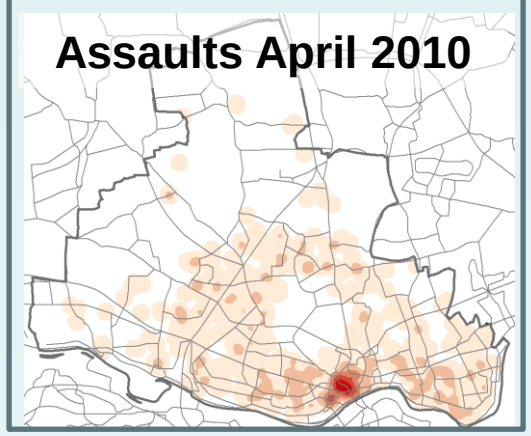


# Predicting the near future

## Patterns that predict: *good* hotspot analysis

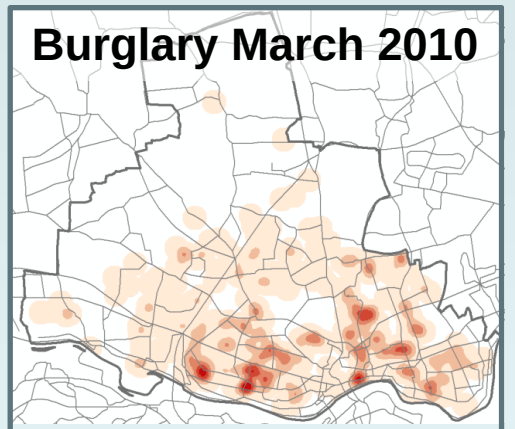
- Where crime concentrates one month
  - Likely to concentrate in same location the next month!

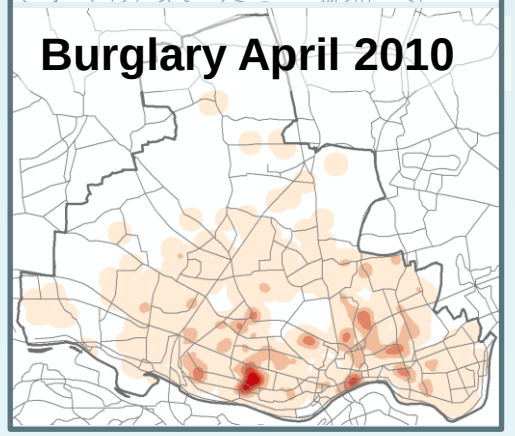



## Example: Newcastle, England

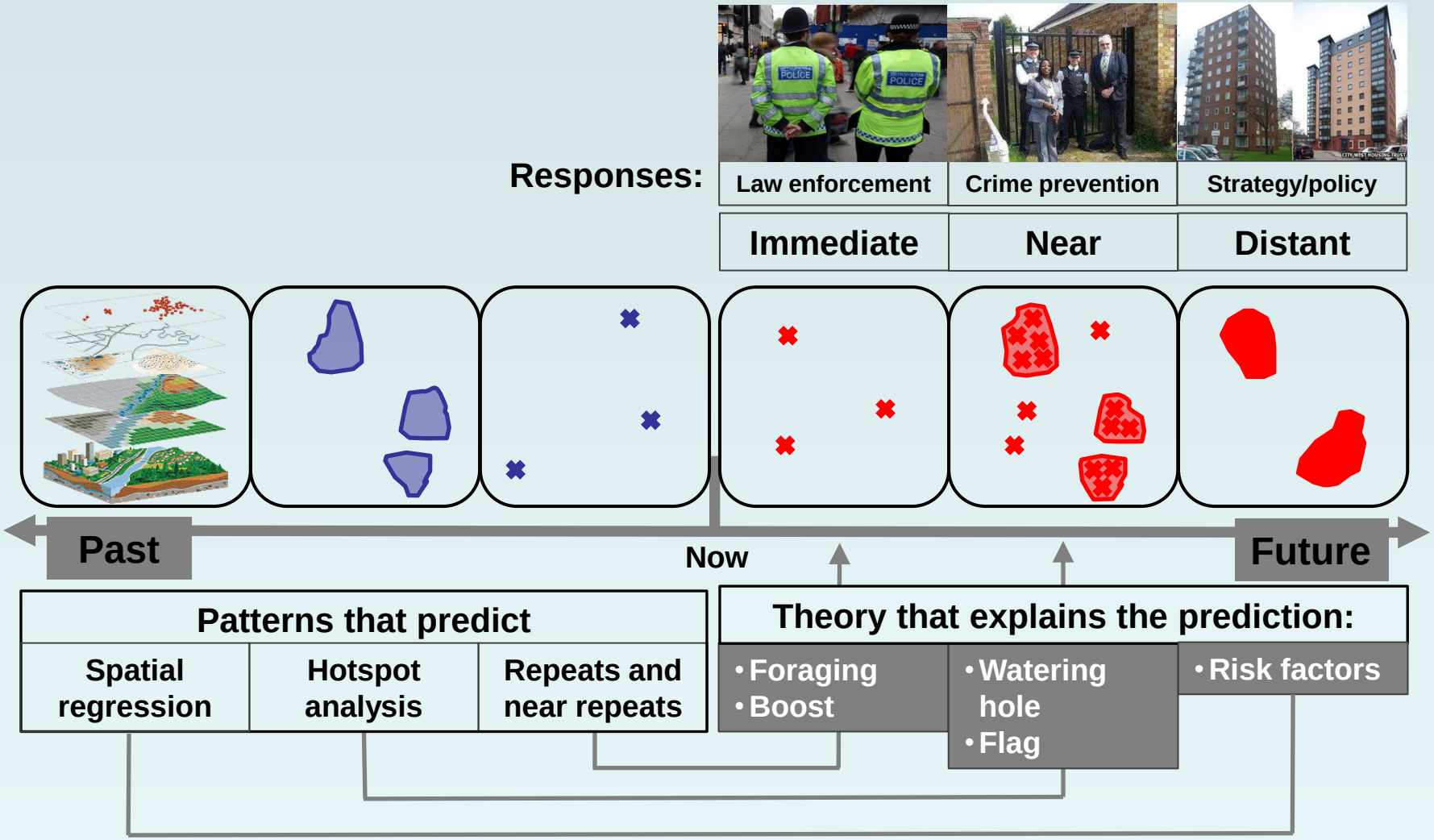
| Crime type | Crimes committed in April 2010 | Number of crimes in hotspots | Percentage of crimes in hotspots |
|---|---|---|---|
| Burglary dwelling | 130 | 21 | 16% |
| Theft from the person | 60 | 41 | 68% |
| Theft from vehicle | 190 | 48 | 25% |
| Assault with injury | 154 | 68 | 44% |



# Predicting the distant future

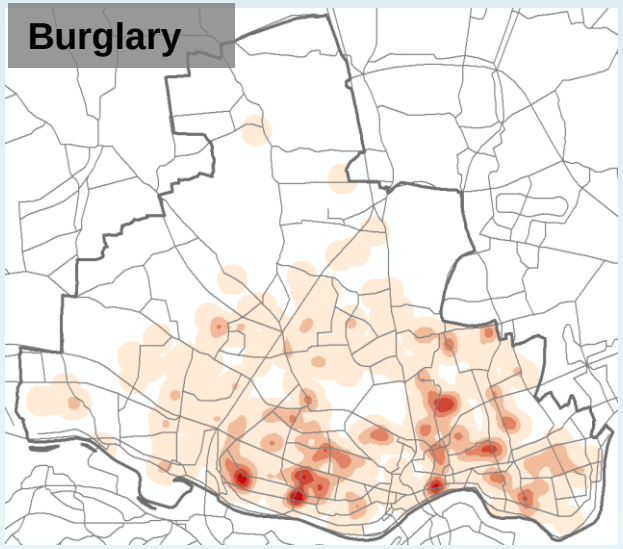
## The Crime Prediction Framework

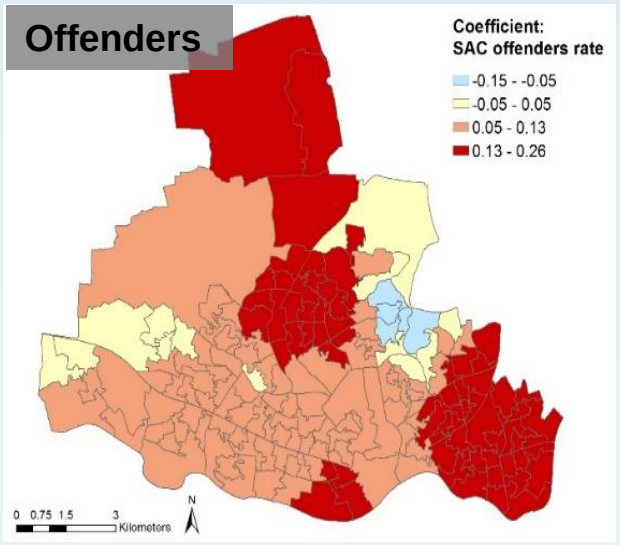


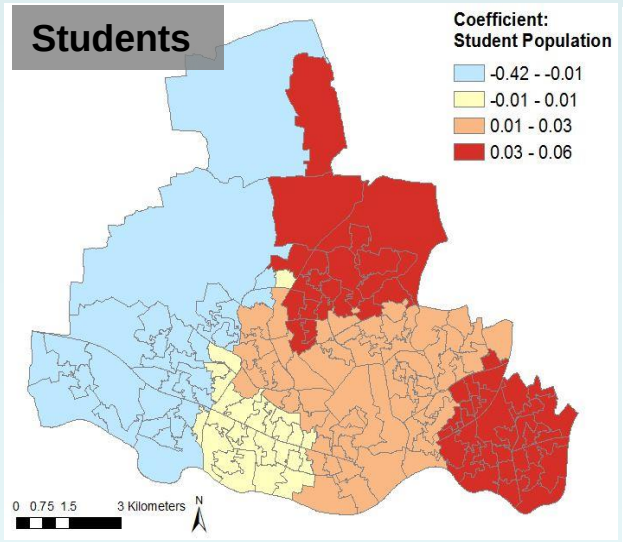
# Predicting the distant future

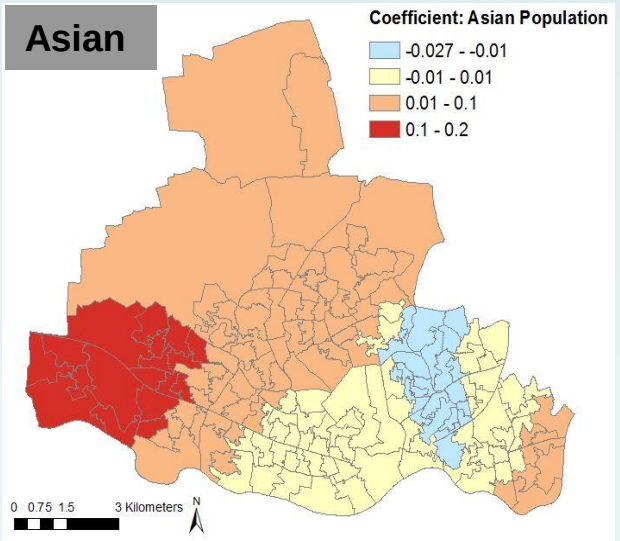
## Patterns that predict: spatial regression

- Identifying those variables that are statistically related to distribution of crime
  - Geographically Weighted Regression – identifies spatially varying relationships
- Coefficients can be used to help *predict* how change in explanatory variable is likely to influence change in crime
- Example: domestic burglary in Newcastle, UK
  - Significant variables: burglary offenders, student population, Asian population



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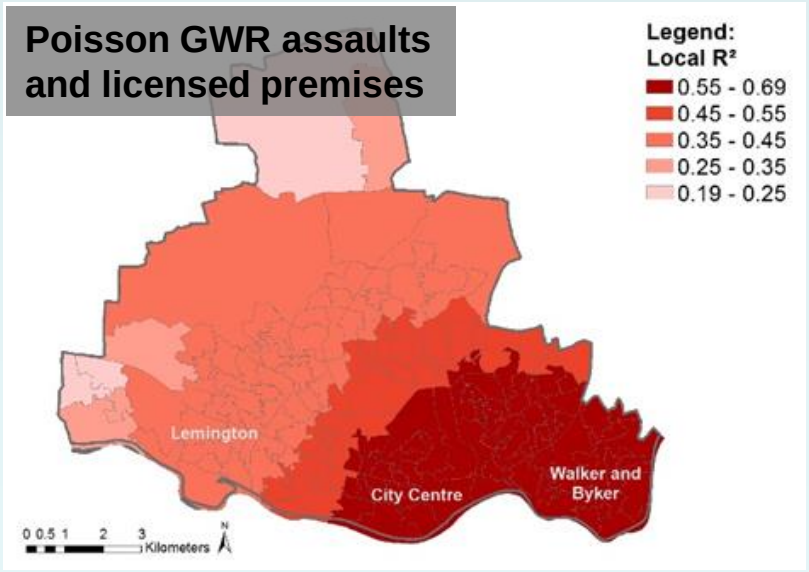
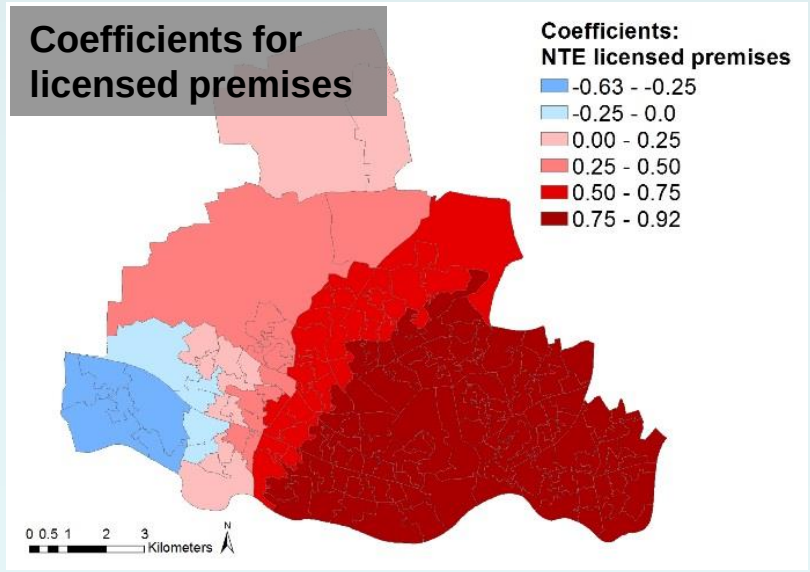
- Example: violent assaults in Newcastle, UK
  - City centre: 10% increase in pubs, bars and nightclubs could yield 9% increase in assaults

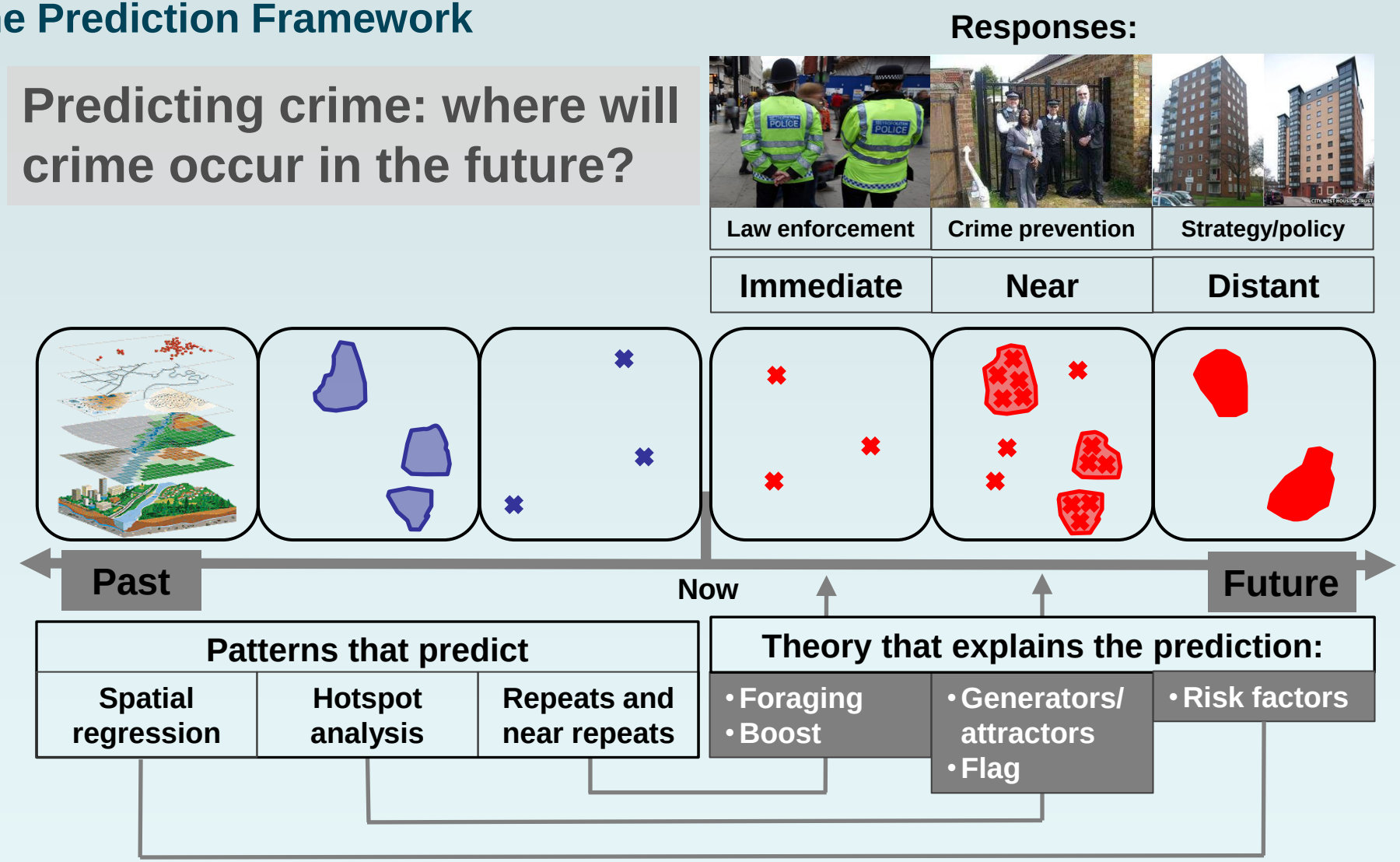


# Summary

## The Crime Prediction Framework

**Predicting crime: where will crime occur in the future?**



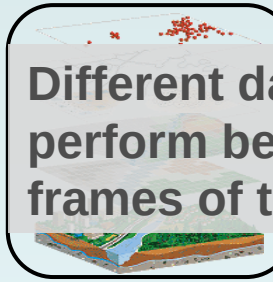
# Summary

## The Crime Prediction Framework

**Predicting crime: where will crime occur in the future?**

**Responses:**

| Law enforcement | Crime prevention | Strategy/policy |
|---|---|---|
| Immediate | Near | Distant |



**Different data, different techniques perform best for different time frames of the future**

**Need to consider what we mean by the future**

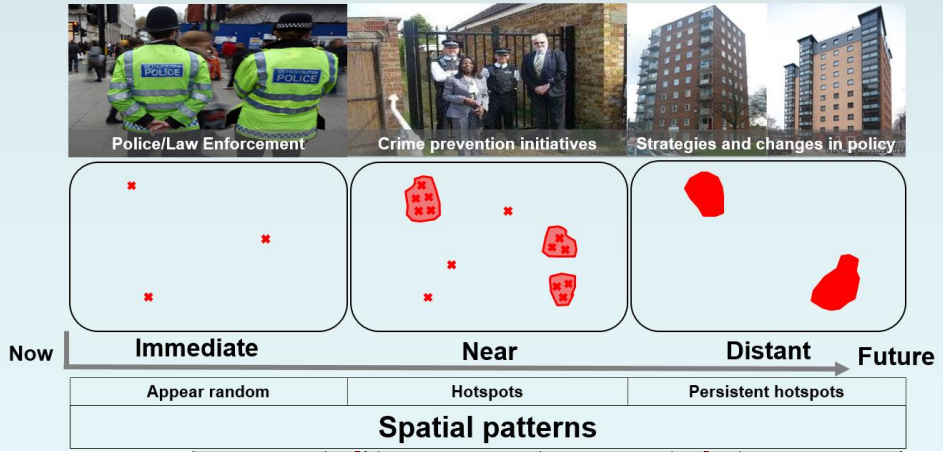
**Past** — **Now** — **Future**

**Prediction performance of mapping techniques provides a benchmark against which other techniques can be compared**

**Theory that explains the prediction:**

- Foraging
- Boost
- Generators/ attractors
- Flag
- Risk factors

# A year of crime in Newcastle (October 2013 to September 2014, n = 24,259)




- How many of these crimes could have been predicted?
- How would they have been prevented?

**Prediction extent estimates:**

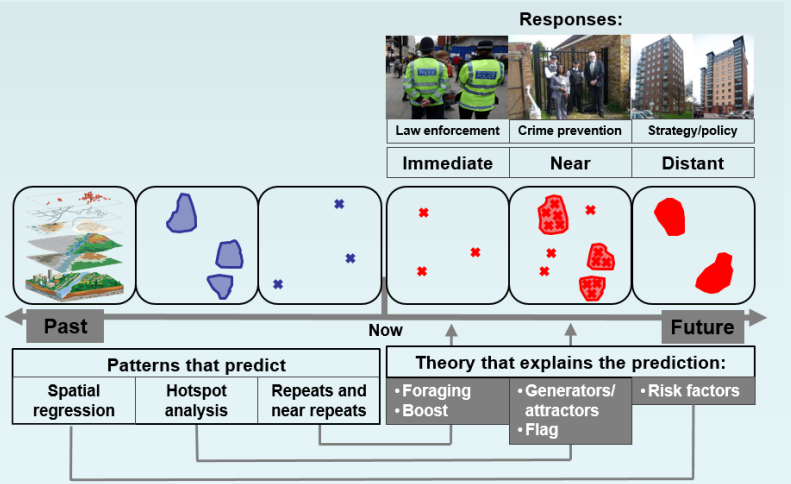
25% - Repeats + near repeat patterns

Further 25% - hotspots

Further 20% - persistent hotspots

# Conclusions

- Reducing crime and improving public safety is not only about tackling the immediate future
  - Predictive policing approach that purely orients itself to the immediate future results in placing more onus on police/law enforcement as the sole reduces of crime
  - Undermines opportunities for shifting/sharing responsibility with other partners
- Crime Prevention Framework
  - Aligning predictions to service responses: immediate, near, distant
  - Crime prediction is sensitive to the retrospective data used and to spatial-temporal patterns of crime
- Prediction is not only about where and when …
  - Need to explain **why** so you can determine what to do to counter the predicted activity and who (other than police) is best placed to respond

# Thank you

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University College London
W: www.ucl.ac.uk/scs
E: s.chainey@ucl.ac.uk
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