• Conf 14h à15h
5 October 2013

Hôtel de Ville, Grand Salon
Conférence en anglais «Smart Cities, Virtual Realities, and Big Data in the Global Age» par Michael Batty, Lauréat du Prix Vautrin Lud 2013

FESTIVAL INTERNATIONAL DE GEOGRAPHIE
Saint-Dié-des-Vosges, capitale mondiale de la Géographie
Christian Pierret, Président Fondateur

SAINT-DIÉ-DES-VOSGES

Prix Vautrin Lud

Smart Cities, Virtual Realities & Big Data in the Global Age

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http://www.complexcity.info/
http://www.spatialcomplexity.info/

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Thanks, and Apologies

What This Lecture will be About

We invent ideas and then these ideas reinvent us

Nowhere is this more true than in technology, in the development of computers

And suddenly we are beginning to see computers taking over cities – reinventing cities and changing our behaviour

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There is a famous quote from Winston Churchill from 1943 that says it all:

"We shape our buildings and then they shape us"

So this lecture will be about the power of ideas to understand the city while at the same time these same ideas are changing it.

This means changing the geography of the city

Outline

- Smart Cities: A New Paradigm?

- An Old Exemplar 1: Land Use Transport Modelling

- An Old Exemplar 2: 2D into 3D – Symbolic into Iconic

- Exemplar 3: Public Transport Networks & Flows

- Exemplar 4: Public Bike Schemes: Local Routing and Local Models of Movement

- Exemplar 5: Crowd-Sourcing and New Data: Sources from Social Media

- Where Do We Go From Here? The Next 100 Years

Smart Card Data
Oyster Card Taps

Tap at **start** and **end** of train journeys

Tap at **start only** on buses

Accepted at 695 Underground and rail stations, and on thousands of buses

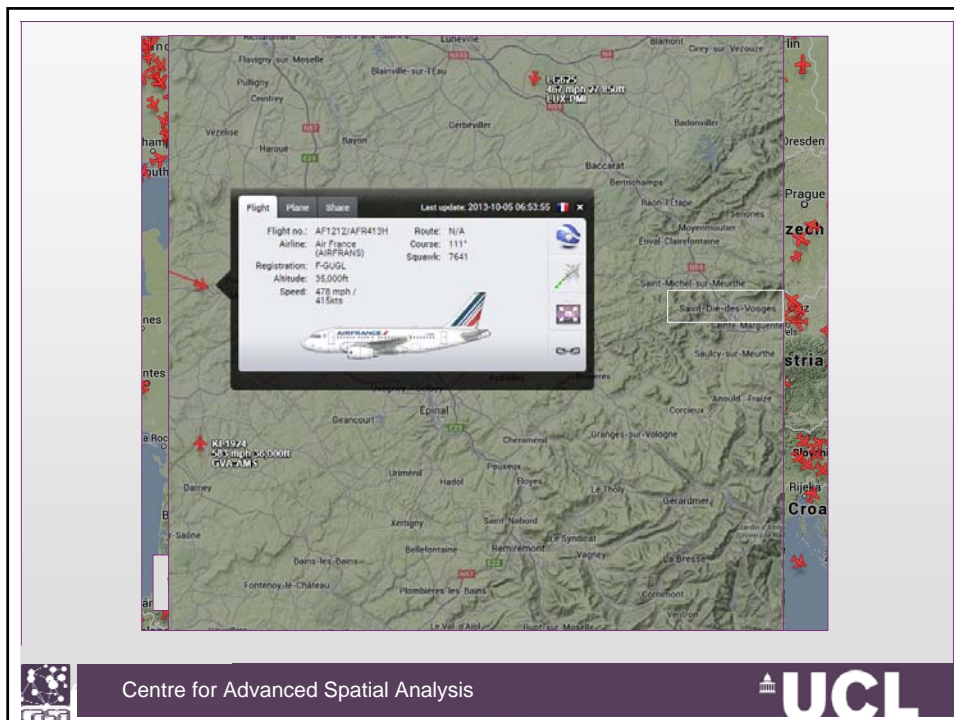**991 million** Oyster Card taps over Summer 2012 – this is big data

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And how can we make sense of this

http://www.simulacra.info/

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Smart Cities: A New Paradigm

What then is the smart city? This is a peculiarly American word

Well cities where computers are being used to make them more efficient, and perhaps more equitable

Essentially computers have moved out of the corporate and individual domains into the collective domain of the city – to control things and to deliver services

They are also used to help our understanding and planning the city – and this is the idea that we used them to understand how they are being used

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What is happening is that we are getting a much better sense of the short term changes in the city. Much of our geographic science of the city is about how it changes over the long term – the very long term like the rise of cities in China over years and decades

But the smart city is about what happens in the next 5 minutes or the next 5 hours or even the next 5 days

This is changing our ability to respond and it is also changing our abilities to function in cities – our behaviour. This lecture is an example - informed by my access to the web and pulling down things like the China Daily page on Smart Cities

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By putting sensors into the built environment and also linking them to ourselves, then great streams of data are being released

This is Big Data: a Billion Oyster card records in 3 months – now you can't use an Excel spreadsheet to analyse that

Smart Cities and Big Data are strongly related. But we have to question just how smart all this hype is

So what have we learnt and what are we learning? What is the geography of the smart city? Let us see through my examples most taken from London.
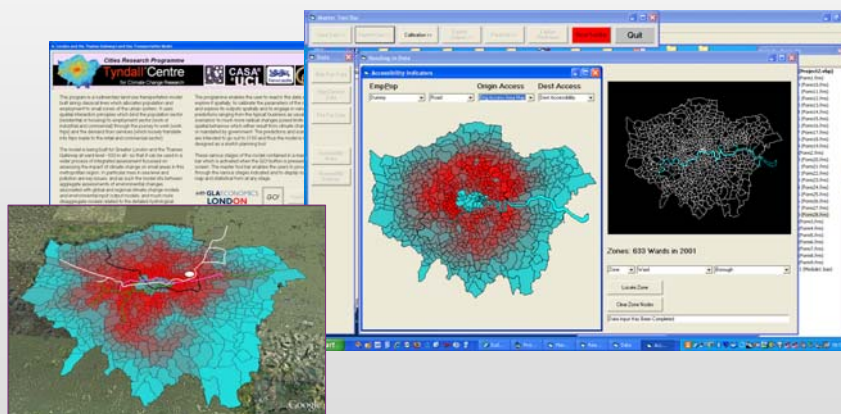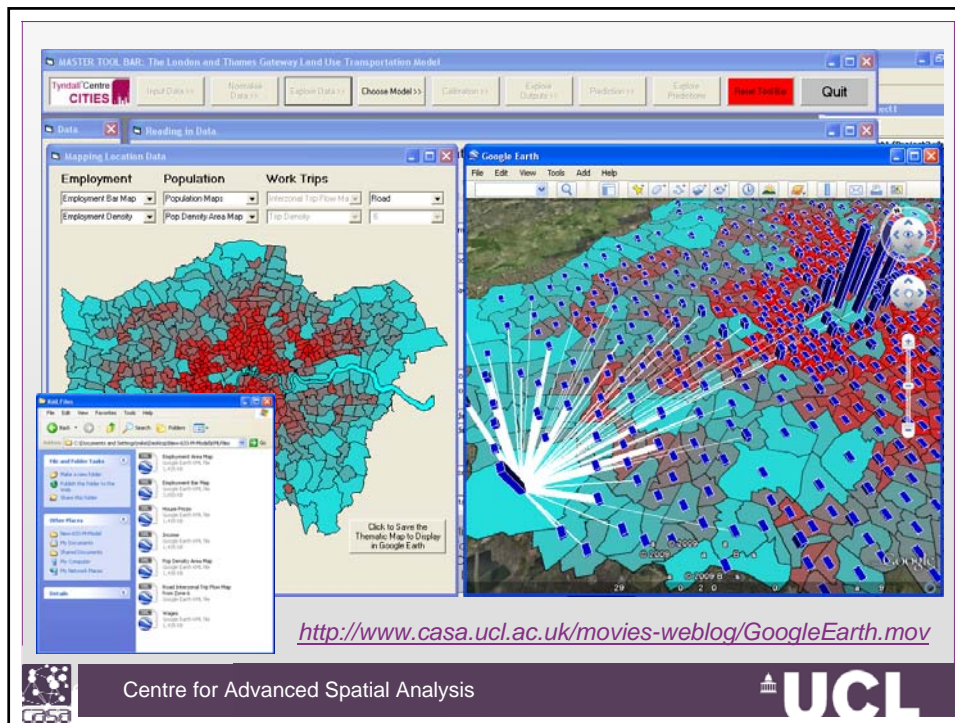
An Old Exemplar 1: Land Use Transport Modelling

Our core expertise is in land use transportation modelling and we have several such models for the London region:

http://www.casa.ucl.ac.uk/movies-weblog/GoogleEarth.mov

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An Old Exemplar 2: 2D into 3D – Symbolic into Iconic

We have built a large scale 3-D model for London based on RS data at parcel levels. The model is different from our LUT models – requiring different skills

The models are being tagged with socio-economic data. We have used it for flooding, visualising air pollution, we have looked at the morphology of building form, and used it to visualise 2D to 3D design proposals.

What is intriguing is the way *iconic and symbolic models are beginning to merge* – land use transport models with virtual city models. We are not yet in the realms of the smart city but you can see how our computers are beginning to help us understand and communicate ideas better across the web.
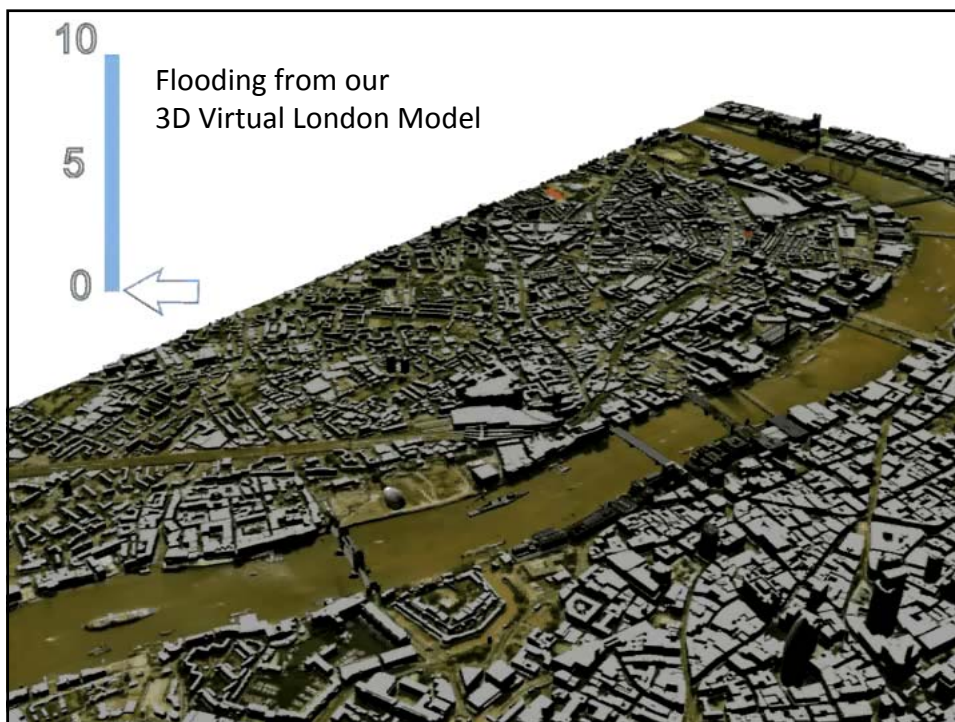
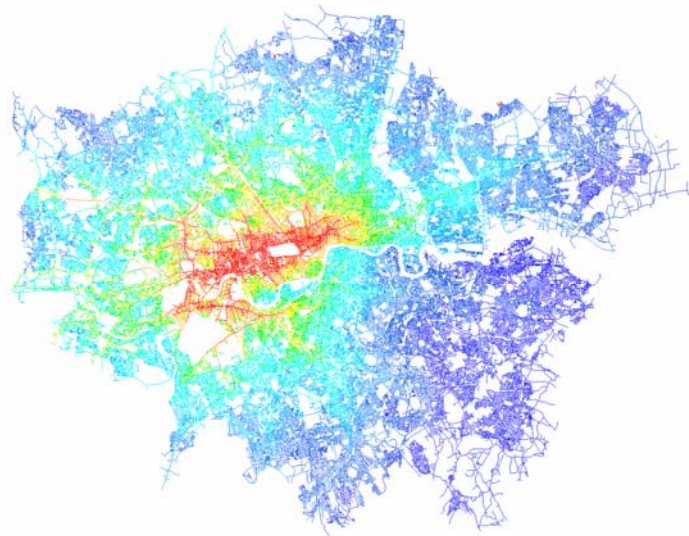Centre for Advanced Spatial Analysis

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http://www.londonair.org.uk/

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Flooding from our
3D Virtual London Model

Shifts in Traffic Accessibility if all Bridges across the Thames are Inoperable as far West as Hammersmith

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Exemplar 3: Public Transport Networks & Flows

Many new sources of network data now exist, much of coming from digital sources and we are working with mining this data and extracting functionality from it

Our key data sets are telecoms data (landline) for the UK, the online travel card data (Oyster) for public transport schemes in London which is massive, really massive and the online bike movement data for the London bikes scheme. These are big data sets that record every phone call, trip etc over a period of days with each object time stamped. Let me show some more of the smart card Oyster project first
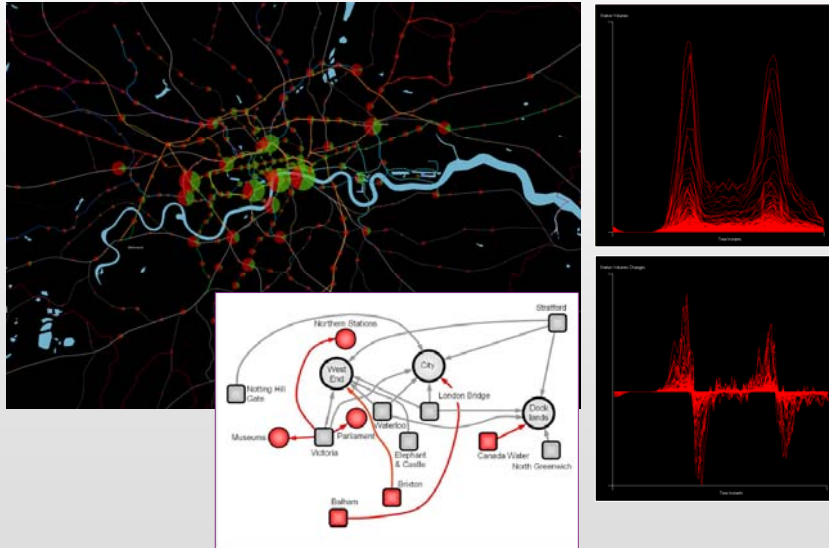
I have shown you the flows but there are many things we can do with all this – like work out disruption on the network and inform travellers – eventually in real time

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Oyster Card Data – interpreting urban structure, multitrips, etc.

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We can examine origins volumes, destination volumes separately and we are doing but here we will simply add these together as total volumes – in this sense they will not have meaning any longer as trips

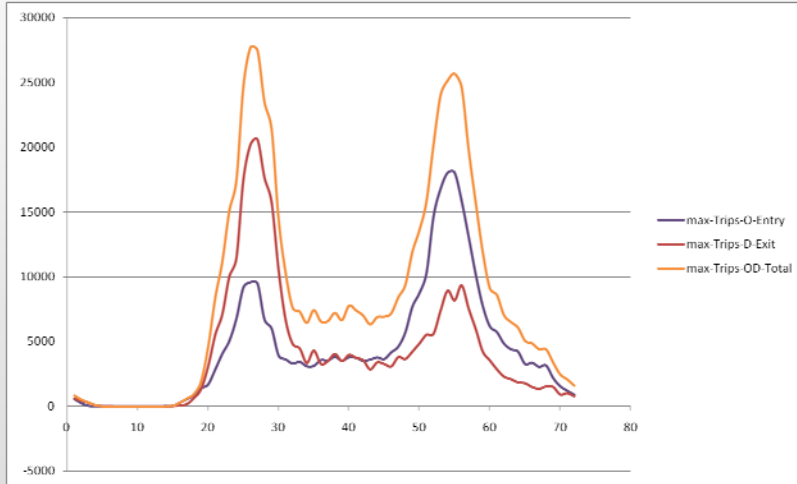|	A	B	C
1	1	London-Bridge	599568
2	2	Victoria	502127
3	3	Waterloo	486861
4	4	Liverpool-Street	437658
5	5	Kings-Cross	395919
6	6	Shepherd's-Bush	346027
7	7	Hammersmith	274623
8	8	Wimbledon	198913
9	9	Paddington	196067
10	10	Vauxhall	180411
11	11	Stratford	177964
12	12	Oxford-Circus	150704
13	13	Charing-Cross	149290
14	14	Ealing-Broadway	139911
15	15	Euston	138394
16	16	Canary-Wharf	132206
17	17	Barking	112842
18	18	Balham	111090
19	19	Brixton	108814
20	20	London-Terminals	93026

We will now examine the profiles of behaviour during the 24 hour day to provide some sense of the problem
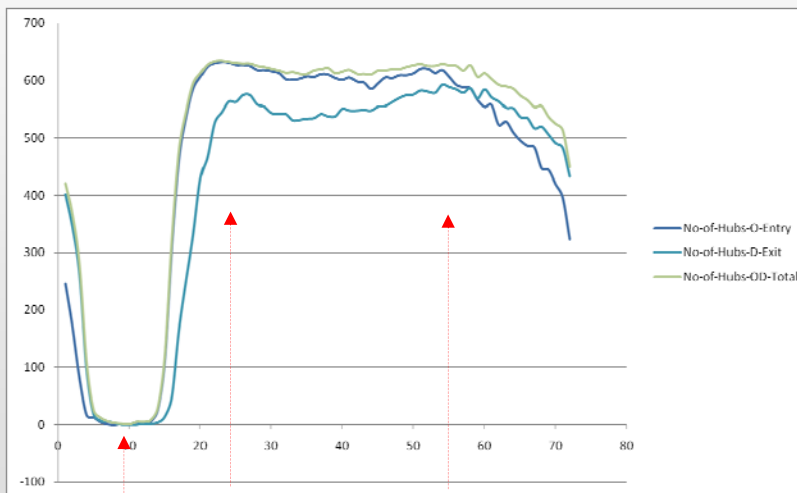
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Examining the Dynamics of the Hub Volumes
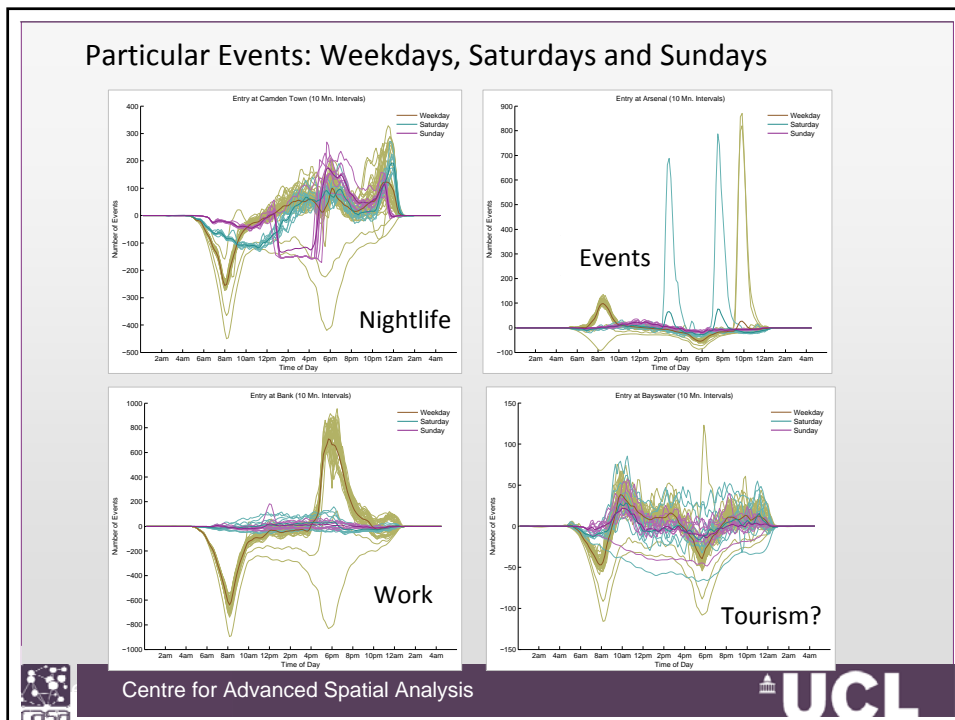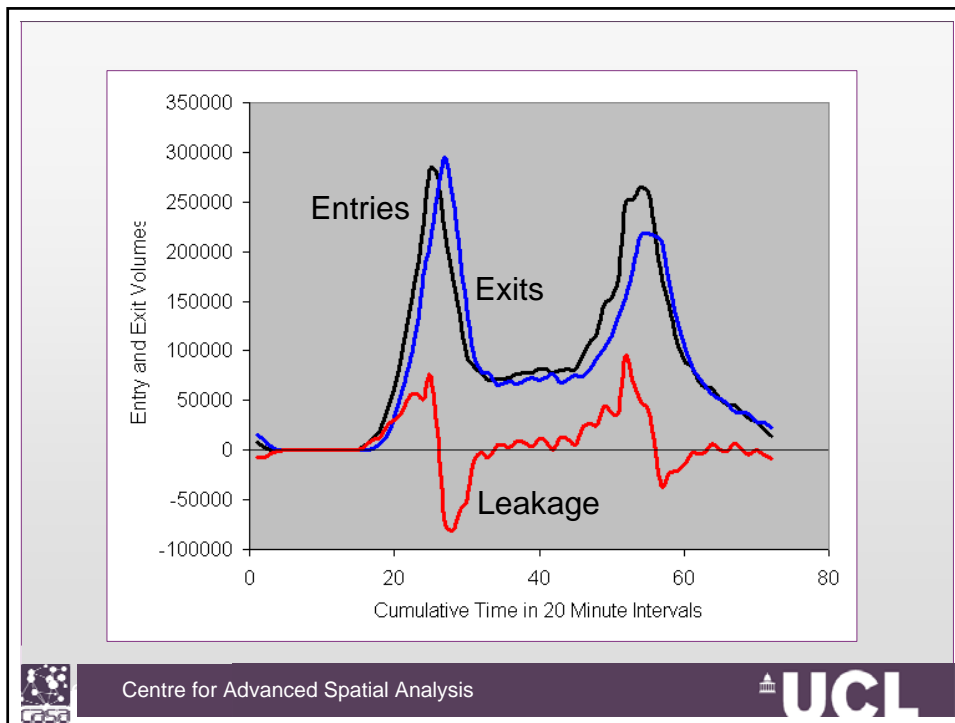

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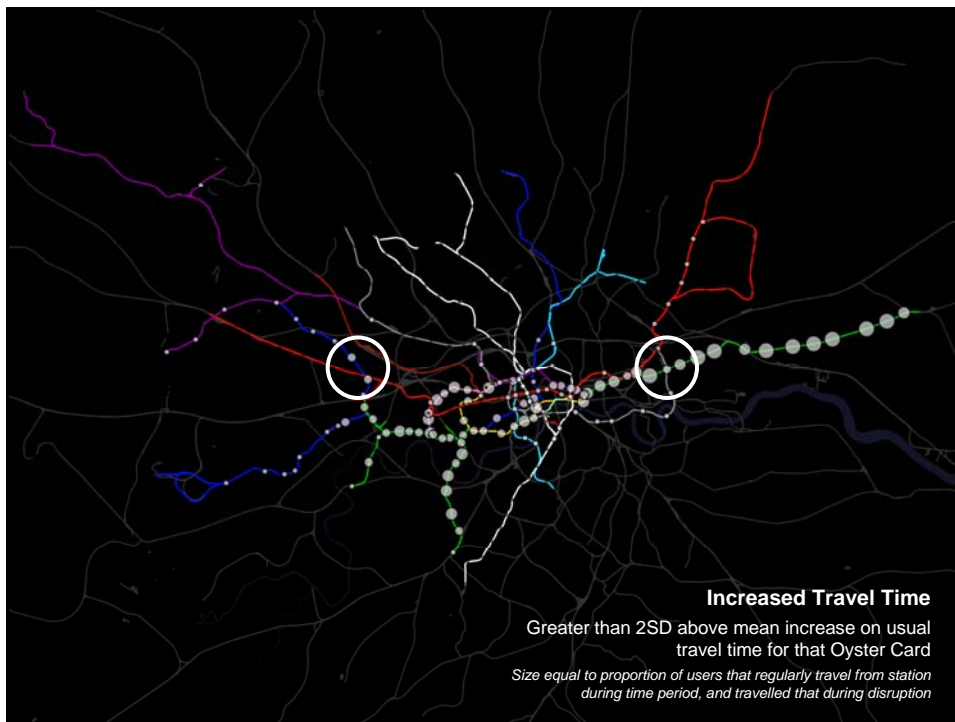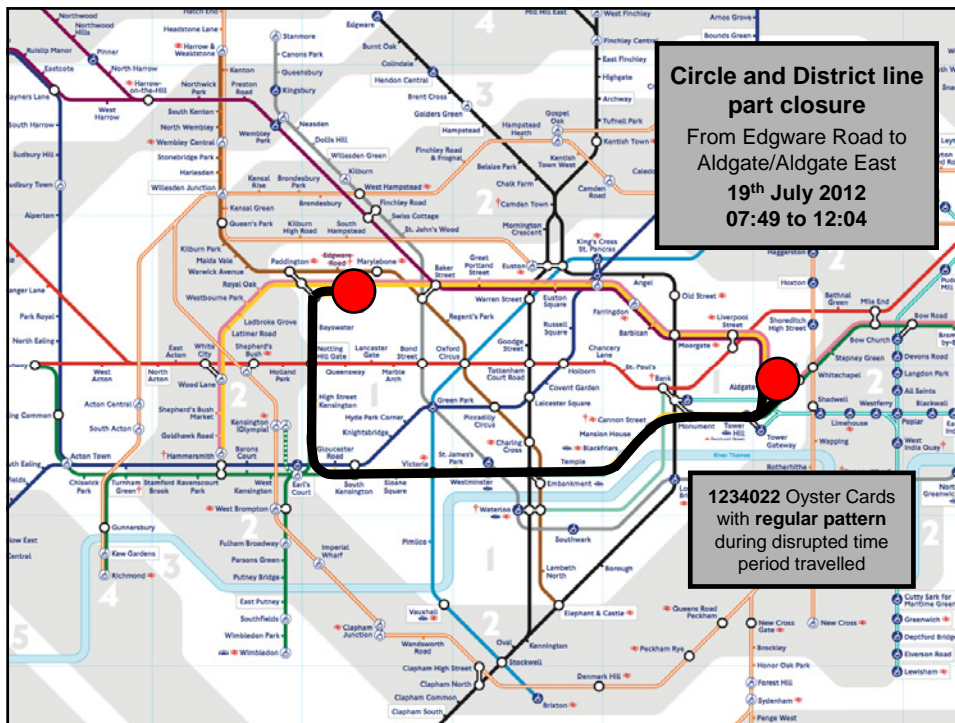Night   am peak   pm peak

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Circle and District line part closure
From Edgware Road to Aldgate/Aldgate East
19th July 2012
07:49 to 12:04

1234022 Oyster Cards with regular pattern during disrupted time period travelled

Increased Travel Time
Greater than 2SD above mean increase on usual travel time for that Oyster Card
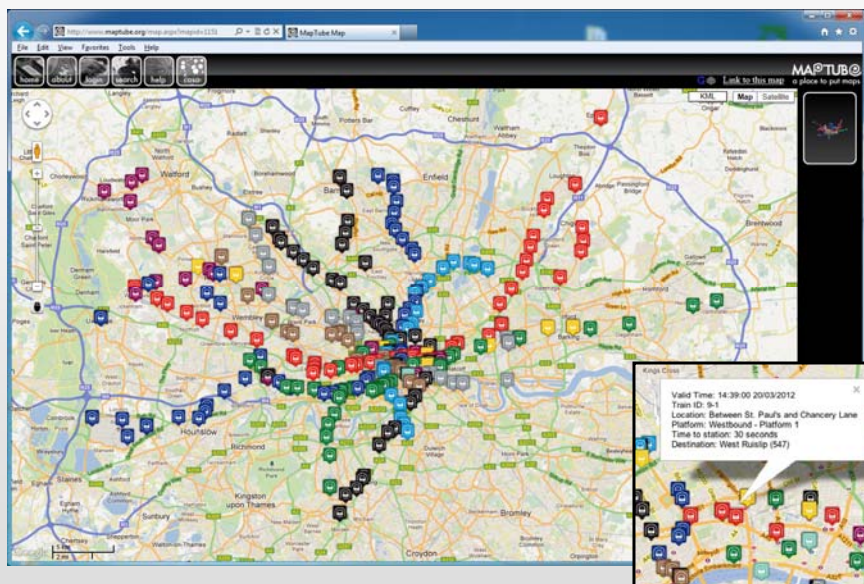*Size equal to proportion of users that regularly travel from station during time period, and travelled that during disruption*

The Public Transport System in Terms of Vehicle Flows
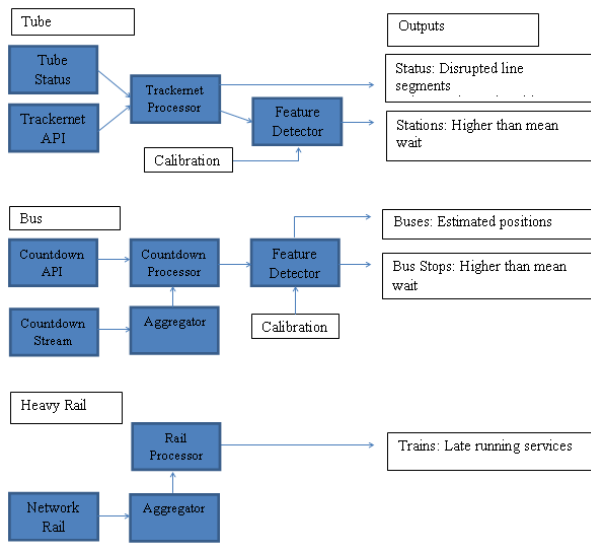
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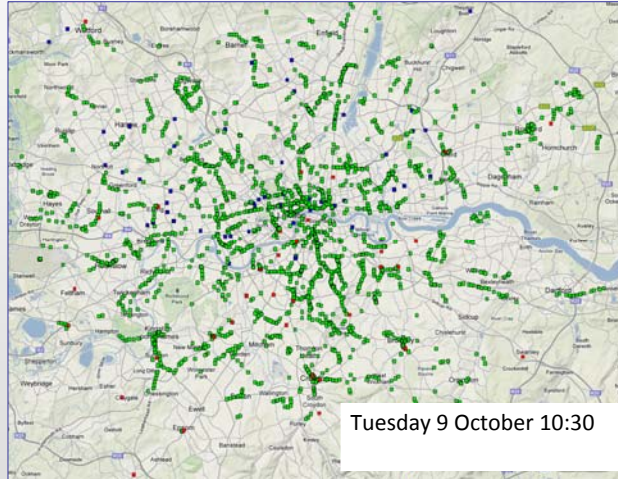
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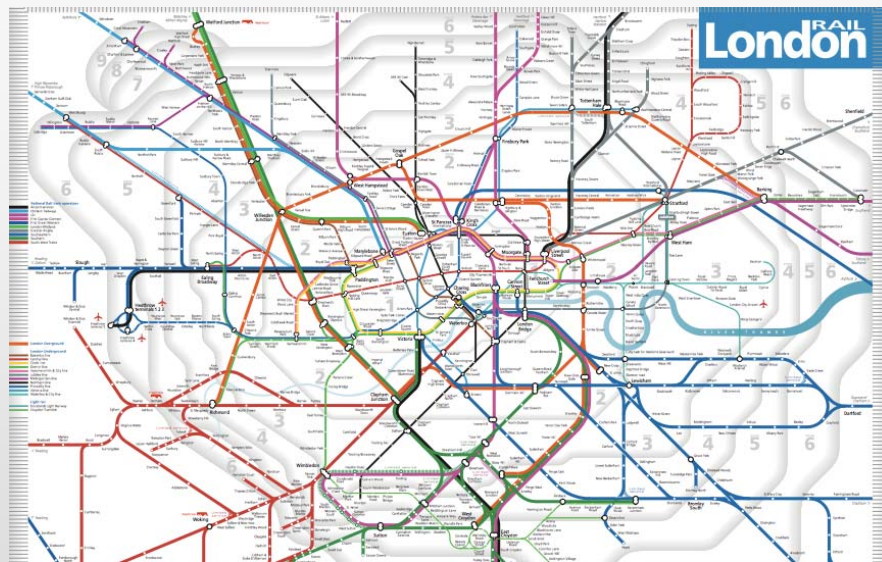
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Delays from Tube, National Rail and Bus Fused

Key

National Rail more than 5 minutes late

Tube stations showing a wait time 15% above expected

Bus stops showing a wait time 20% above expected

Tube delays from the TfL status feed are also plotted as lines

Tuesday 9 October 10:30

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Tube, Overground and National Rail Networks in London where Oyster cards can be used
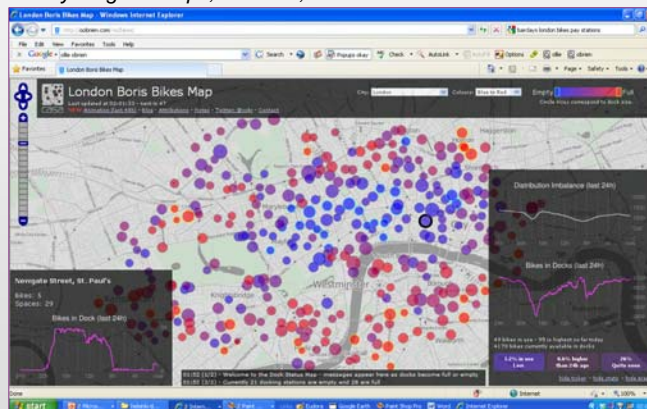
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Exemplar 4: The Public Bike Scheme: Local Routing and Local Models of Movement

Bikes Data – 4200 bikes, started Nov 2010, all the data– everything – all trips, all times, all stations/docks
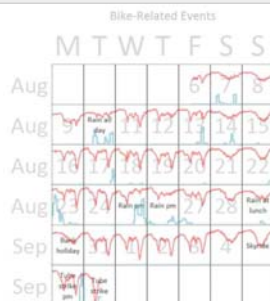
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Animations of Public Bike Movements
Animations of Changes in the Bike Nodes: Docking

More Analysis

- **London**
- Graph shows number of bikes available to hire
- Effect of rain
  – Using the CASA weather station
- Effect of the tube strikes

Bike-o-Meter
casa.ucl.ac.uk/bom

- Tweet-o-Meter for bikes
  – Steven Gray (@frogo)
  – Using Google Gauges
- See the real life Tweet-o-Meters at the new British Library "Growing Knowledge" exhibition
 – Should be easy to hack to show the Bike-o-Meters instead ☺
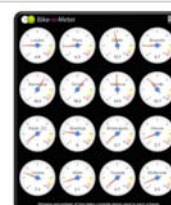
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Simulating Crowds: Fine Scale Modelling and Sensing

In a different tradition but one which is rapidly converging with our interests in sensing and networks, we have developed a number of pedestrian models, first for the Notting Hill Carnival, and then for many town centres
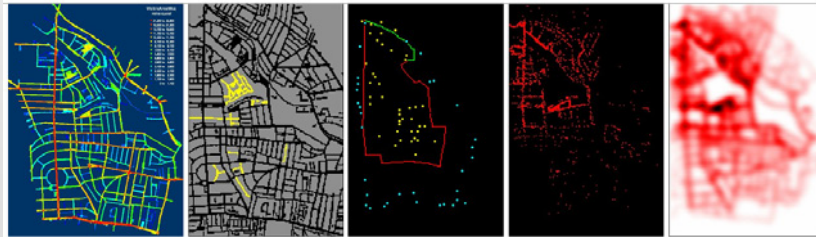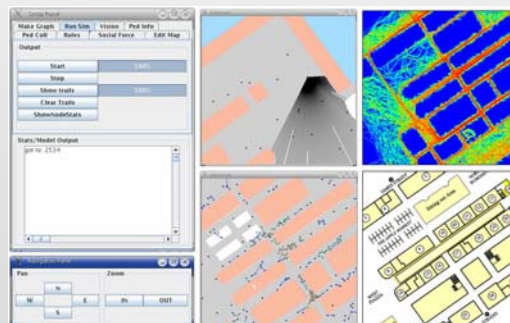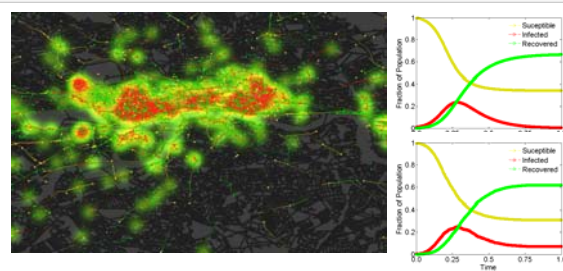

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We are now working on fine scale models which are mirror diffusion and spread in situations ranging from epidemics to evacuation and shopping.

We have a simple model of epidemics on networks in London and we are looking at evacuations of major shopping centres such as Covent Garden (right)

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Let us change tack from sensing to mapping

Exemplar 5: Crowd-Sourcing and New Data: Sources from Social Media

We have a number of mapping projects using Web 2 and these involve using these online mapping systems to elicit simple data from the crowd – but data that is geotagged, hence the production of online maps of the crowdsourced data in real time

We have looked at Manchester congestion charge, anti social behaviour and credit crunch where in all cases we have used the BBC to broadcast the questions and provide the forum for response while our servers and software have produced the maps.
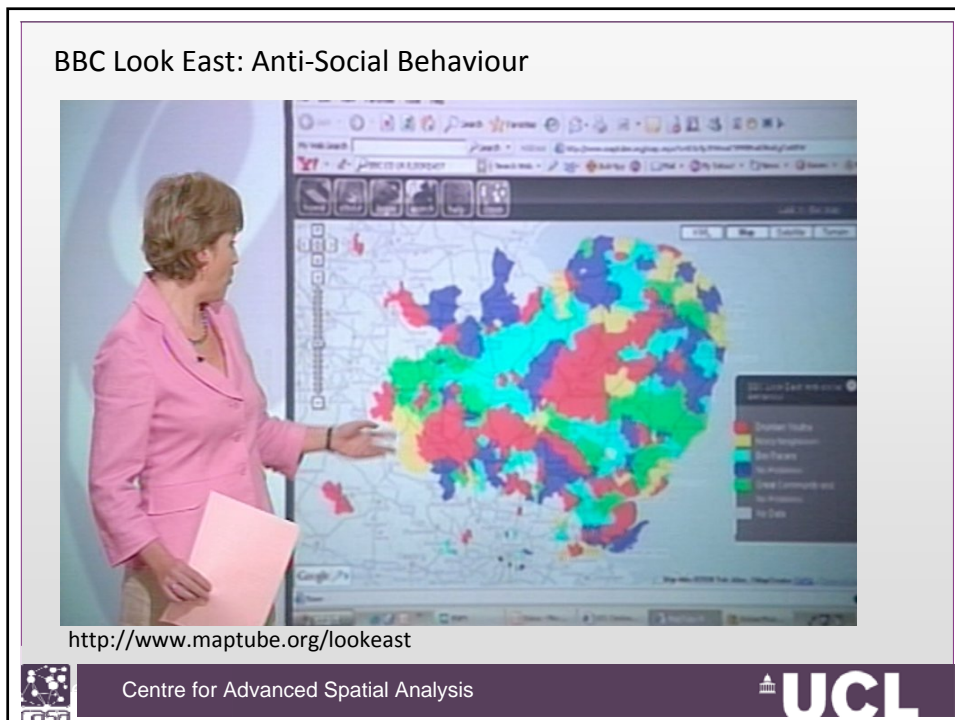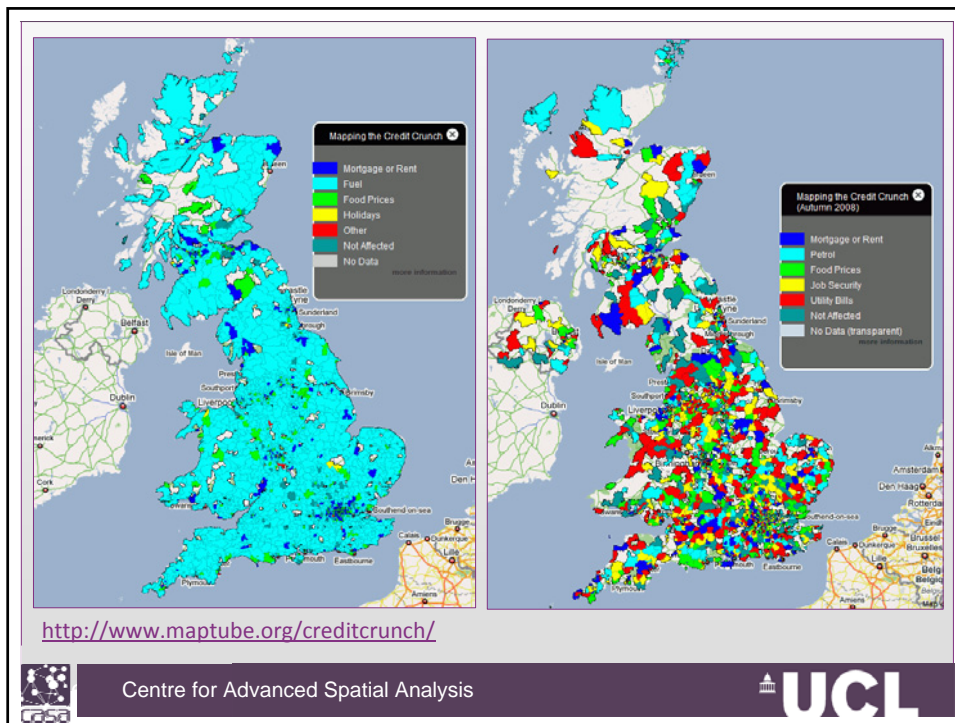
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23,475 responses
April, May, June 2008

A new credit crunch survey started in October and currently has 3,802 responses.

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http://www.maptube.org/creditcrunch/

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BBC Look East: Anti-Social Behaviour
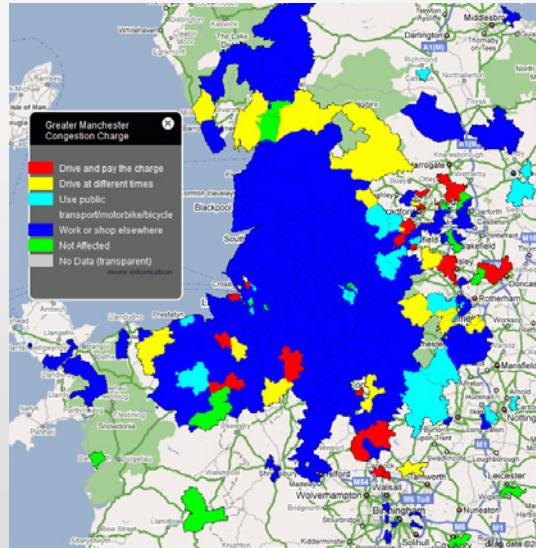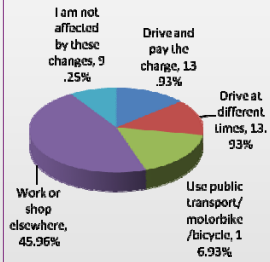
http://www.maptube.org/lookeast

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Manchester Congestion Charge

15,902 responses
October to December 2008

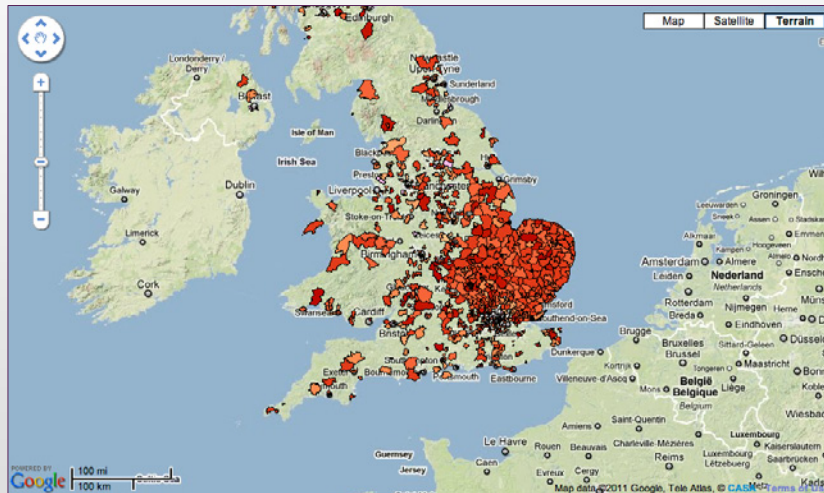Centre for Advanced Spatial Analysis

SurveyMapper

- Real-time Geographic survey tool.
- Up to 50 questions per survey
- Up to 50 answers per question
- Live stats and graphs
- Geographic Regions:
  - Worldwide Countries
  - European Countries
  - UK Counties
  - UK Postcode
  - Adding more soon
- Frequently updating regions

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BBC Look East Survey - Broadband Speed Test

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Extracting and Mapping Social Media

We have started to mine, map, interpret much social media because of the ease of its availability – and we have started looking at Short Text Messaging – Twitter data.

We have also begun to look at phone tracking data – from the iPhone for example but many of our data sets such as the bikes data, the Oyster card and such like data are really part of the same domain of new bottom up data. We have no control over this but some of the social media data we are mining we have greater control over. Here are some examples.
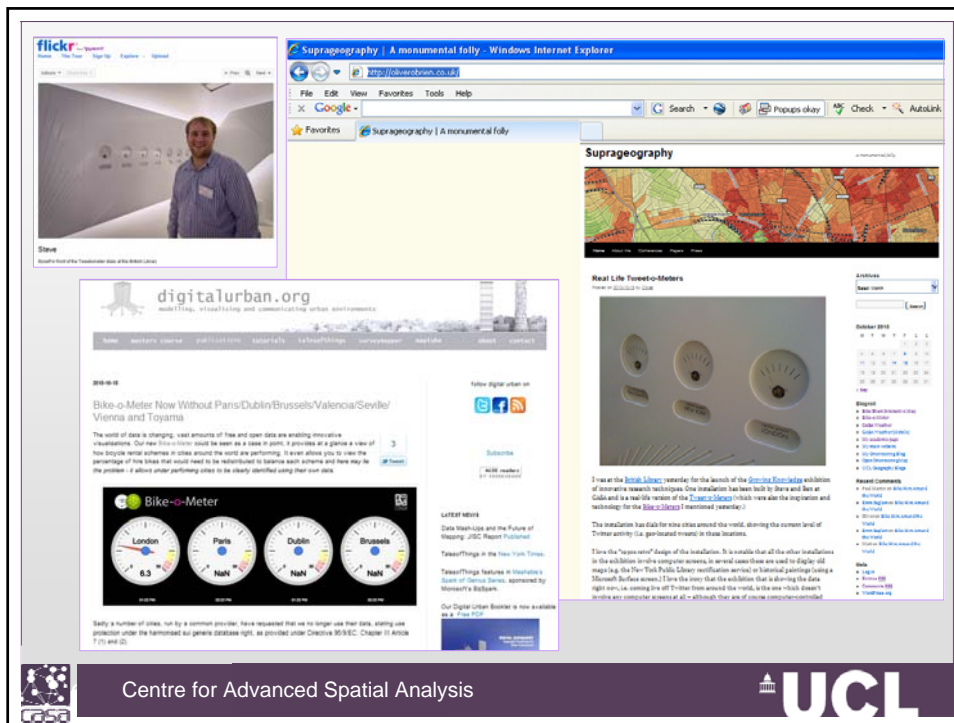
And Here is a Map of Tweets above London which uses our 3D model to visualise these data

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London Twitter Cloud

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New York   London   Paris   Moscow

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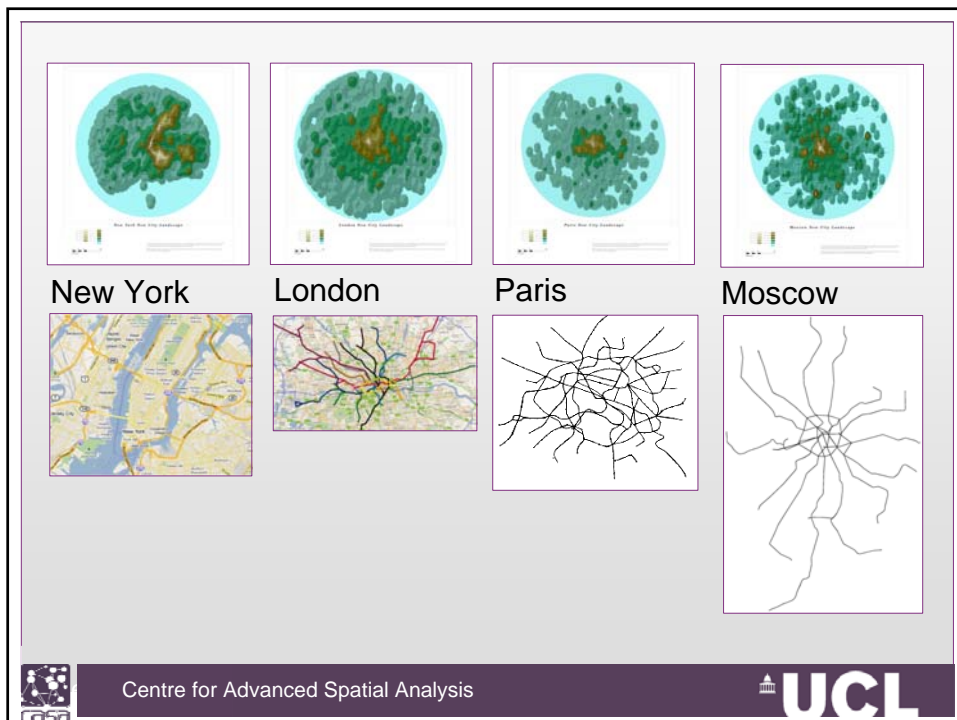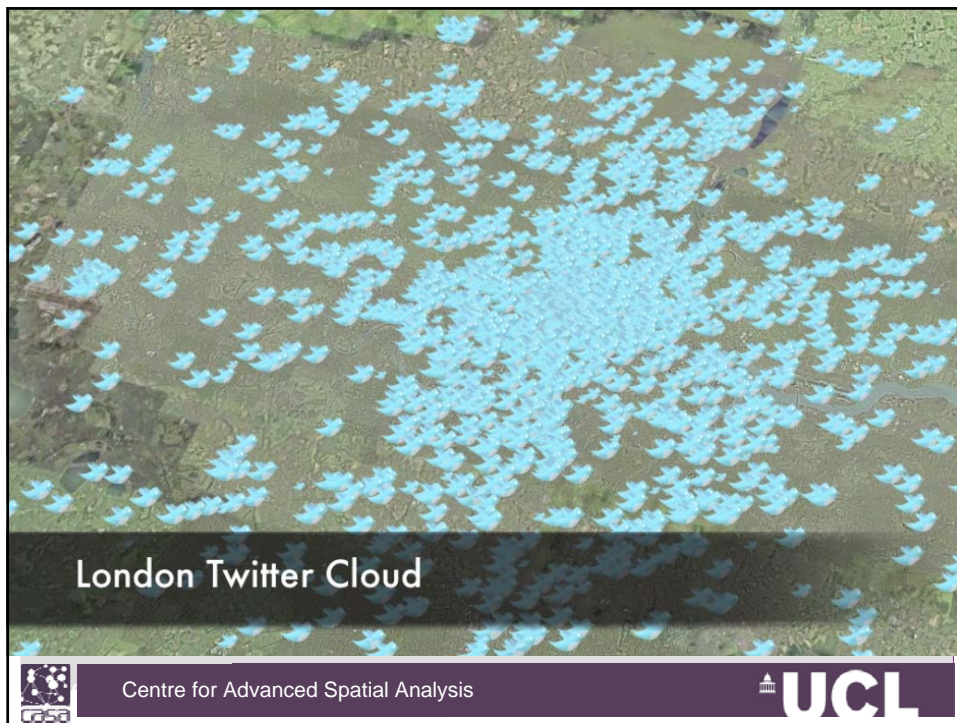
Where Do We Go From Here? The Next 100 Years

I have not mentioned that much of this is being ported to hand held devices – in fact this is obvious

I have not mentioned digital participation which is key to the smart cities movement, indeed reinforces the point you can't have smart cities without smart people.

I think we need to fashion a new science out of this and some of it is coming. This will be built on many ideas of the last century but a lot of new ones too across many different dimensions

Let me finish by saying what we are trying to do– to tie all this together in **A Science of Cities** and our progress in this will always be a moving target as cities continue to change as new technologies are invented which then change us.

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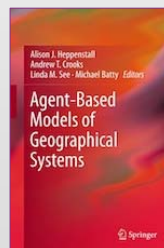
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Thanks

http://www.spatialcomplexity.info/
http://www.complexcity.info/
http://www.mechanicty.info/
http://blogs.casa.ucl.ac.uk/
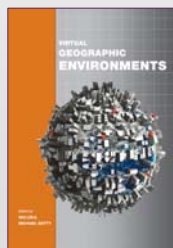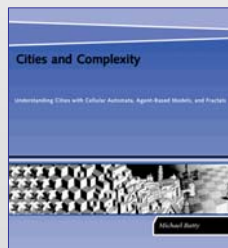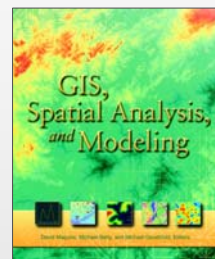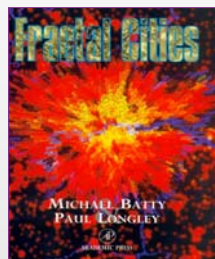*http://www.casa.ucl.ac.uk/*

Acknowledgements

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Some of our books which are about all of this

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