Visualizing Information in Complex Environments
ASSYST-FUTURICT, Torino Italy 17-18 November 2011

Visualising Cities Through Models, Maps & Machines

Michael Batty
University College London
m.batty@ucl.ac.uk
@jmichaelbatty

http://www.complexcity.info/

Centre for Advanced Spatial Analysis

UCL

Outline

A Little Bit of History: The Origins of Visual Computing:

Five Snapshots: Different Perspectives on the City

- Symbolic Modelling: Land Use Transportation: The System
- Scientific Visualisation: Abstracting the Symbolic System but tomorrow the sessions will detail this in some depth – here is simply a taster
- Iconic Modelling: Virtual London
- Representational and Data Modelling: Web2, Online Maps, Crowdsourcing
- Representational Modelling: Fine Scale Motion and Sensing

Centre for Advanced Spatial Analysis

UCL

We should not be surprised that computers are everywhere as right at the beginning, their originators and the philosophers of computation told us they were " universal machines"

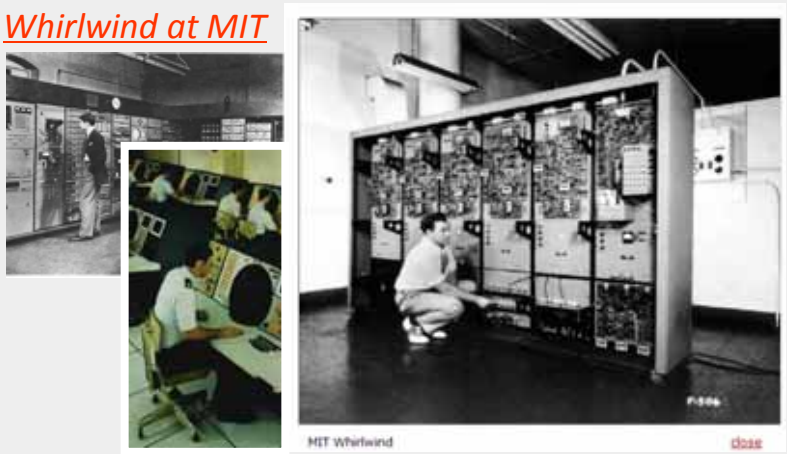
Alan Turing in 1936: "It is possible to invent a single machine which can be used to compute any computable sequence."

Alan Turing in 1948: "A man provided with paper, pencil, and rubber, and subject to strict discipline, is in effect a universal machine.

Alan Turing in 1952: "I believe that at the end of the century the use of words and general educated opinion will have altered so much that one will be able to speak of machines thinking without expecting to be contradicted.

And They Can Draw Pictures: A Little Bit of History: The Beginnings of Visual Computing

Whirlwind at MIT

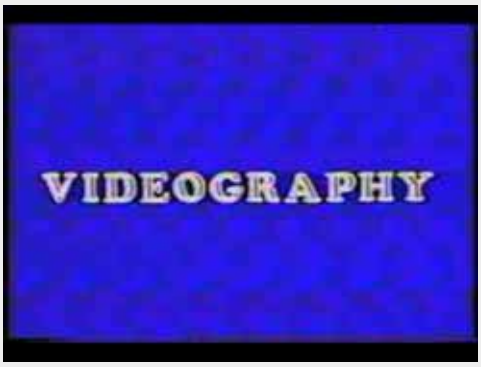


1951

- MIT´s Whirlwind debuted on Edward R. Murrow´s "See It Now" television series. Project director Jay Forrester described the computer as a "reliable operating system," running 35 hours a week at 90-percent utility using an electrostatic tube memory.

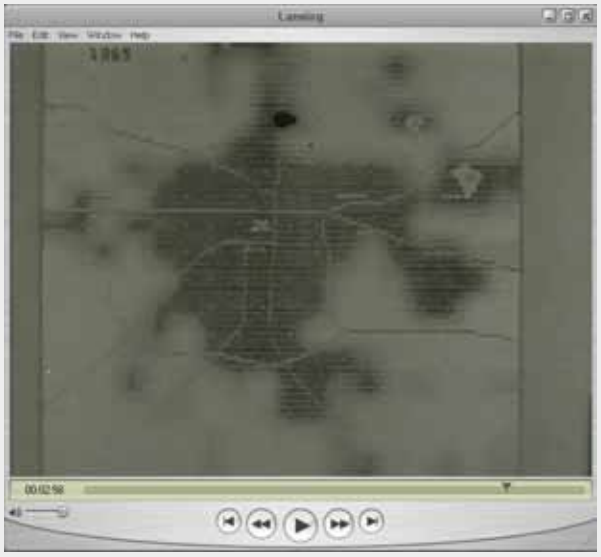
Start of 1945 project:

Completed: 1951

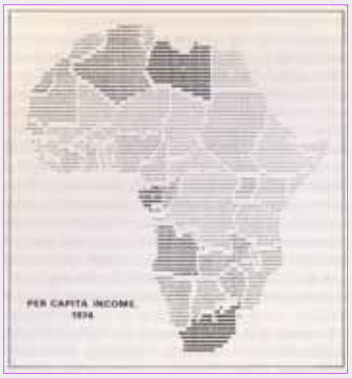


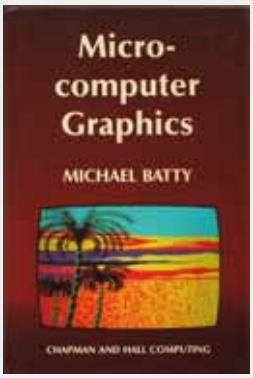
The earliest computer movie I found in YouTube

The first computer movie of urban development we have discovered was produced in 1967 at Michigan State University in East Lansing by Alan Schmidt



Line Printers – Before the age of interactive graphics





Early versions of interactive graphics that I worked on in Melbourne in 1982 and then the development of a WATFor77 version in 1986. It is primitive and not nice to look at …

But the 1986 version is better and it still runs on this computer, just …. Let me show you

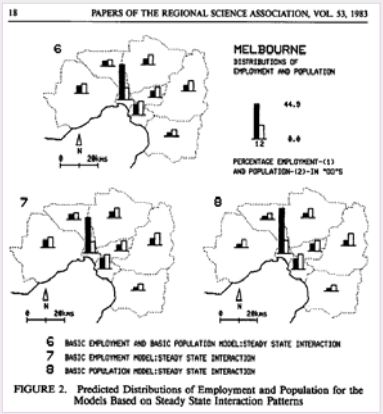


FIGURE 2. Predicted Distributions of Employment and Population for the Models Based on Steady State Interaction Patterns

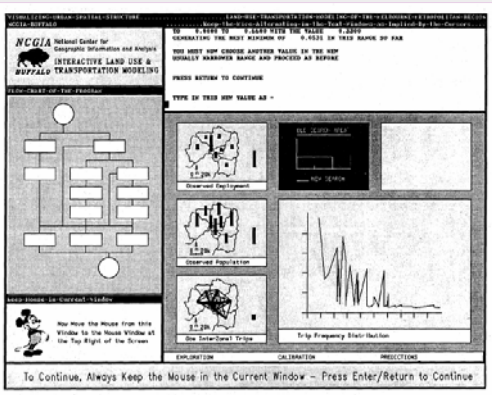


Figure 6. Progress in calibrating the model using dichotomous search.

From a VAX Terminal – A Raster 1982

From a Sun Workstation – Simple Windows - 1991

And then we moved fast to workstations and entered the world of graphics that we take for granted today

Centre for Advanced Spatial Analysis

UCL

Enough of History although we ignore it at our peril

Let me move on to

Visualisation, Interaction and Communication

Despite the technology, the focus in computing has become

- Interactive, spontaneous, immediate.
- visual, iconic, participative.
- communicative, remote, networked ……..

Currently our representations and simulations are being rapidly developed as I will show

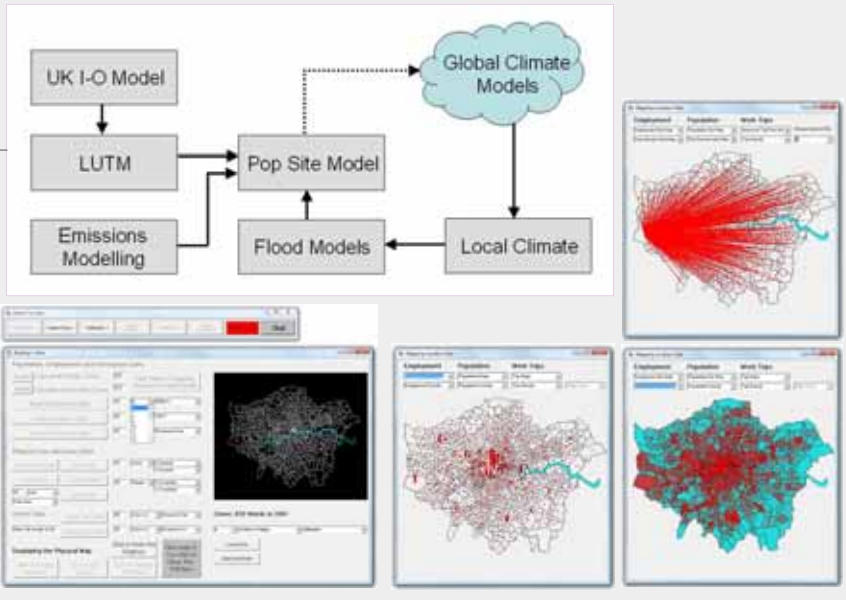
Centre for Advanced Spatial Analysis

UCL

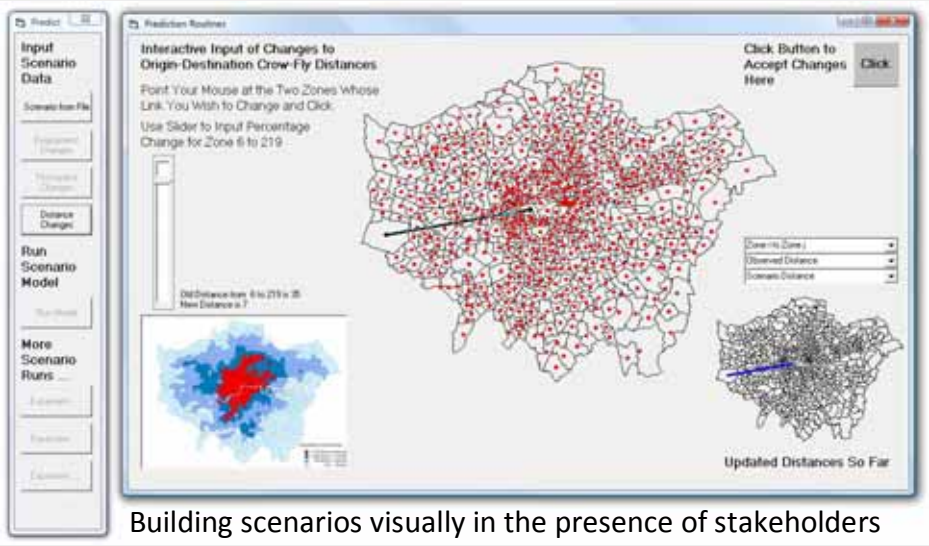
My first example: how do we model the city symbolically, mathematically.

Let me explain what we are doing about simulating the impact of climate change on London as part of the Tyndall Centre's research on cities. I will quickly sketch it but no time to show the model running

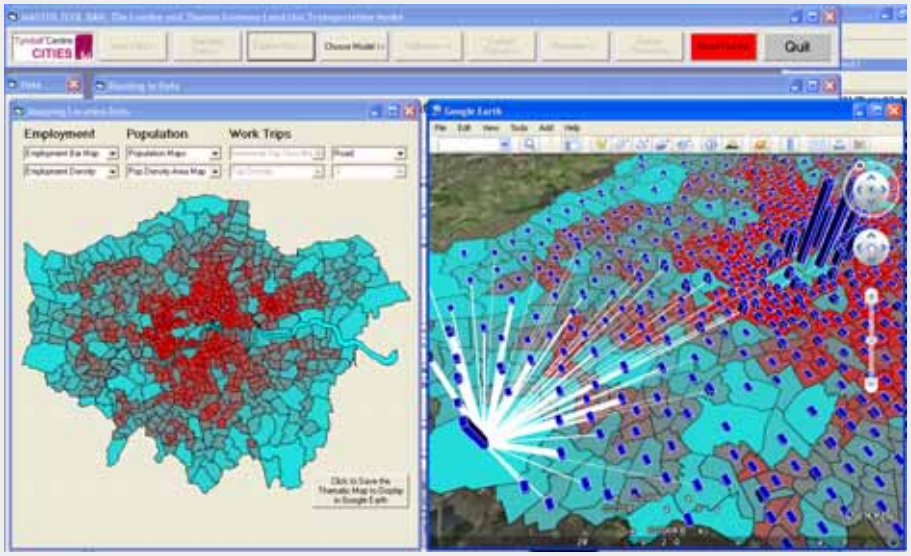
We are building a land use transport model as part of a process of integrated assessment. The key issue is that the model is interactive, immediate, visual and communicates ideas to other professionals involved in the process.



Centre for Advanced Spatial Analysis UCL

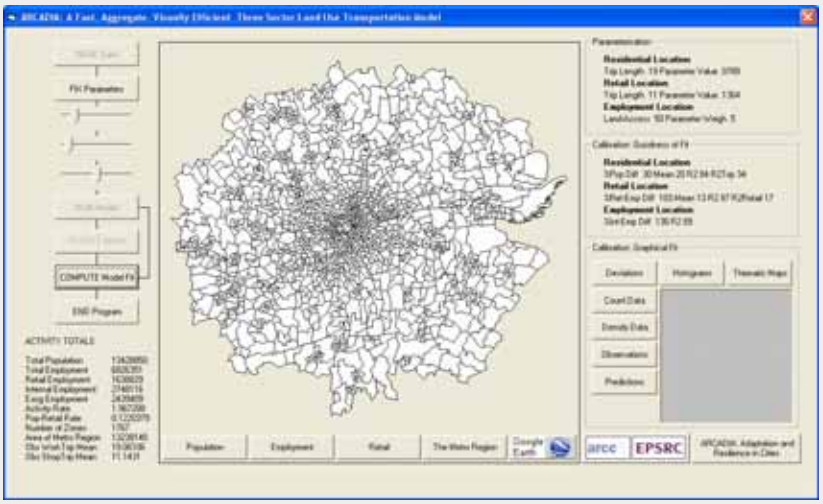


Building scenarios visually in the presence of stakeholders – a dialogue

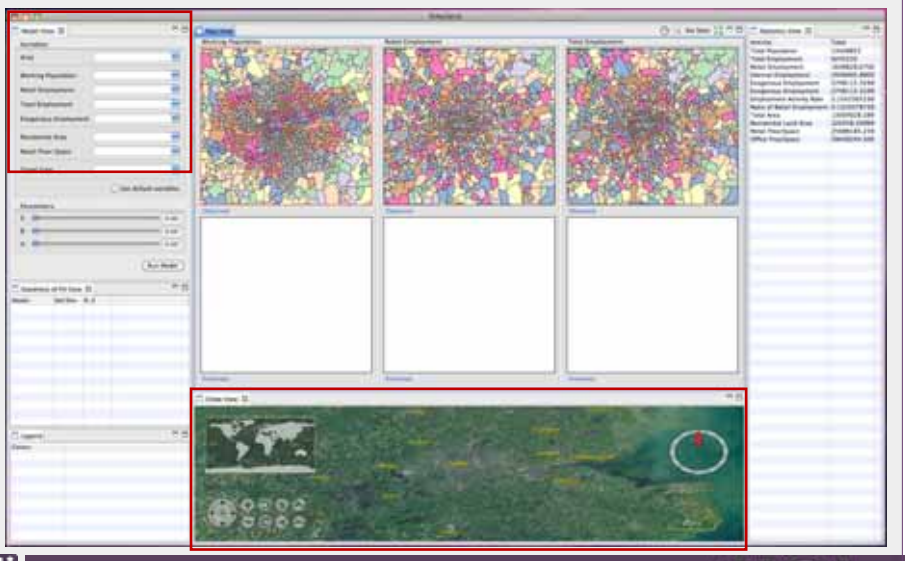


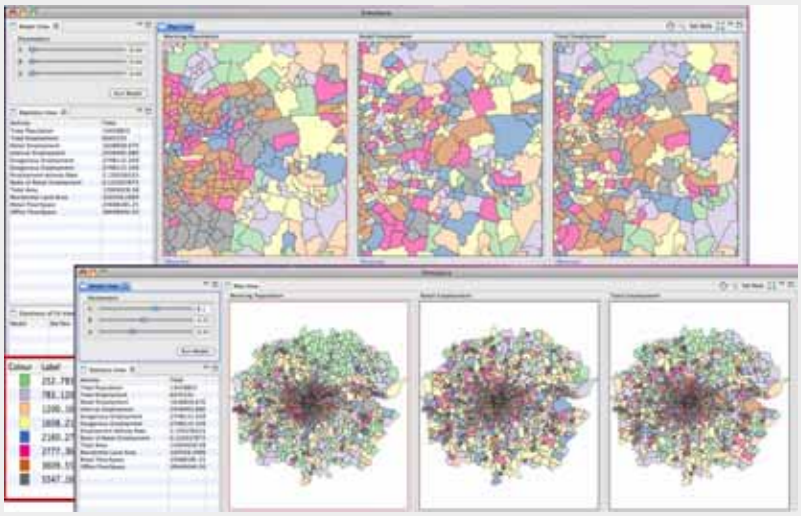
Exporting data and predictions to external software on the fly

The new model is bigger and we are developing a web 2 version all in open source software



The LTUMi Eclipse RCP can look like



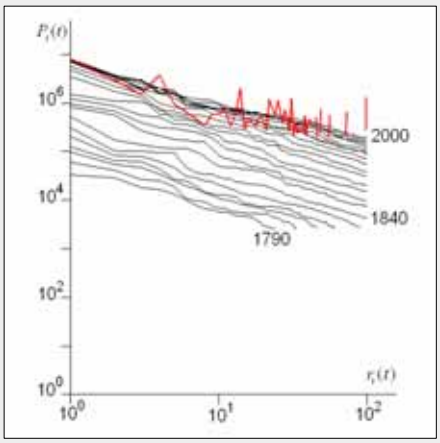


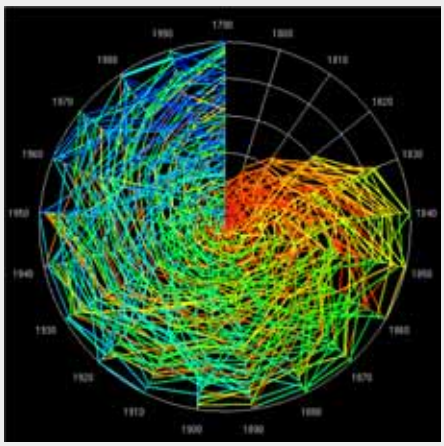
My second example: is based on scientific visualisation which is rather different from this representational visualisation of the system itself

There are many examples where we can visualise the various outcomes from a symbolic model in non-representational terms – as statistical visualisations, utilising the whole panoply of diagrams and charts that one sees in the work of people like Tufte

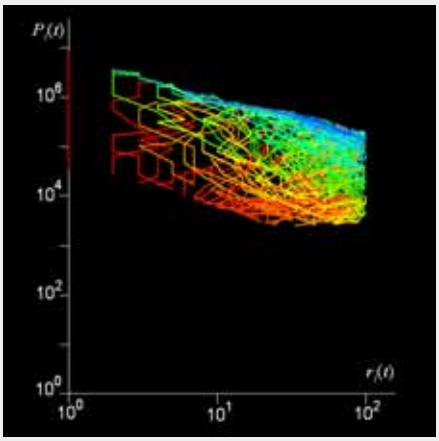
Let me show some examples, our work on systems of cities, using power laws to represent the frequency of sizes

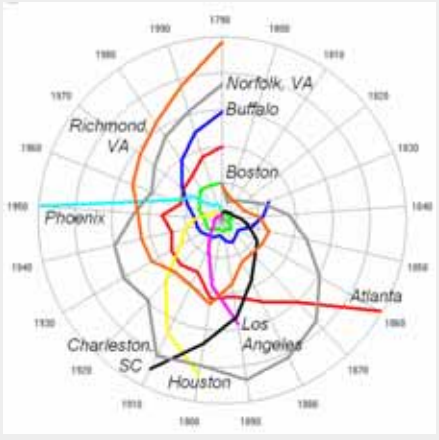
We can plot the relative volatility of notion of cities with the power law envelope using the idea of a rank clock





The 'morphology' of the rank clock should tell us something – i.e. the increase in cities, the volatility of ranks and so on.





The rudimentary software for this in on our web site at http://www.casa.ucl.ac.uk/software/rank.asp

And here is an animation of the US clock .. RankClockUSCities.exe

My third example: how do we model the city iconically, visually.

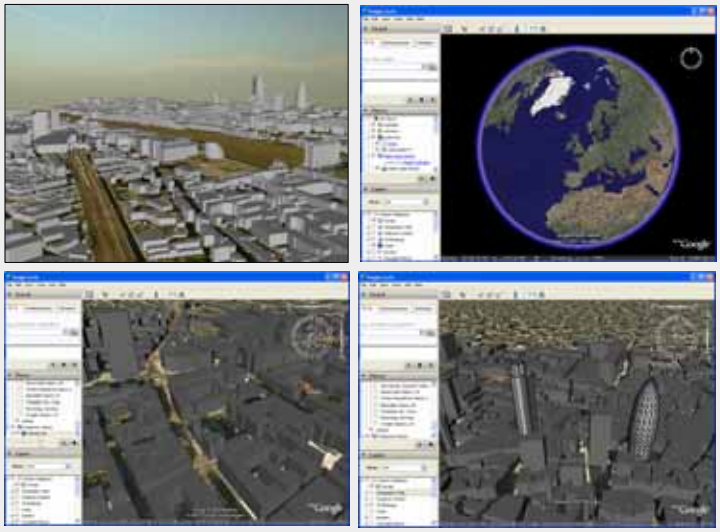
Fifty years ago iconic models were barely conceived as very being digital but our Virtual London model is now a routine digital 'architects' model of the physical form of the city.

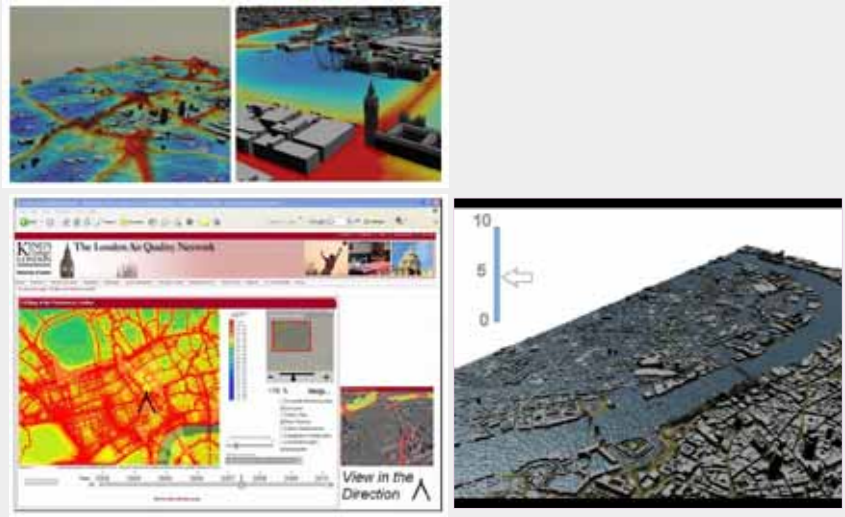
It is built in 3D-GIS, ArcGIS, ported in and out of CAD and Games software, into Google Earth, Second Life, and so on.

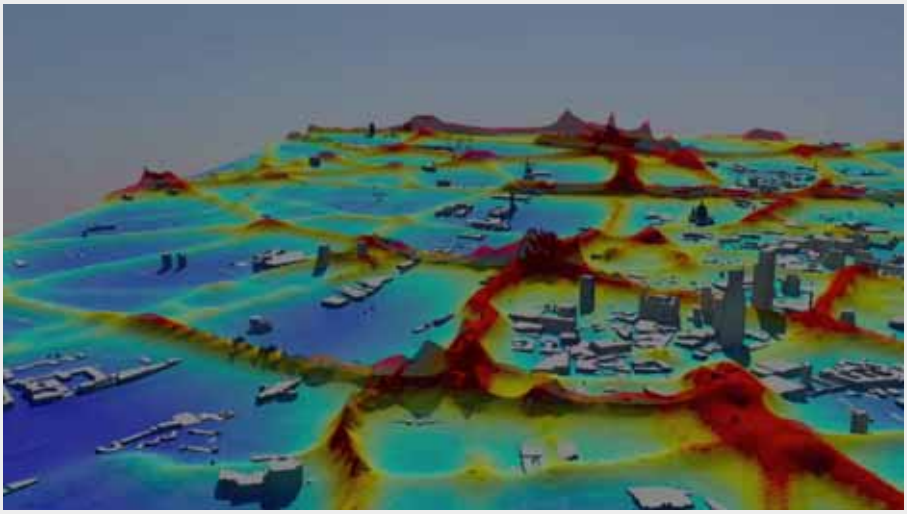
We use it as our test bed for multimedia. This is linked to much of our representational and multimedia work that I will tell you about later.

What can we do with the model, flood it, visualise land use, simulate pollution, test the impact of high buildings

2D to 3D: GIS to CAD and back and on the web





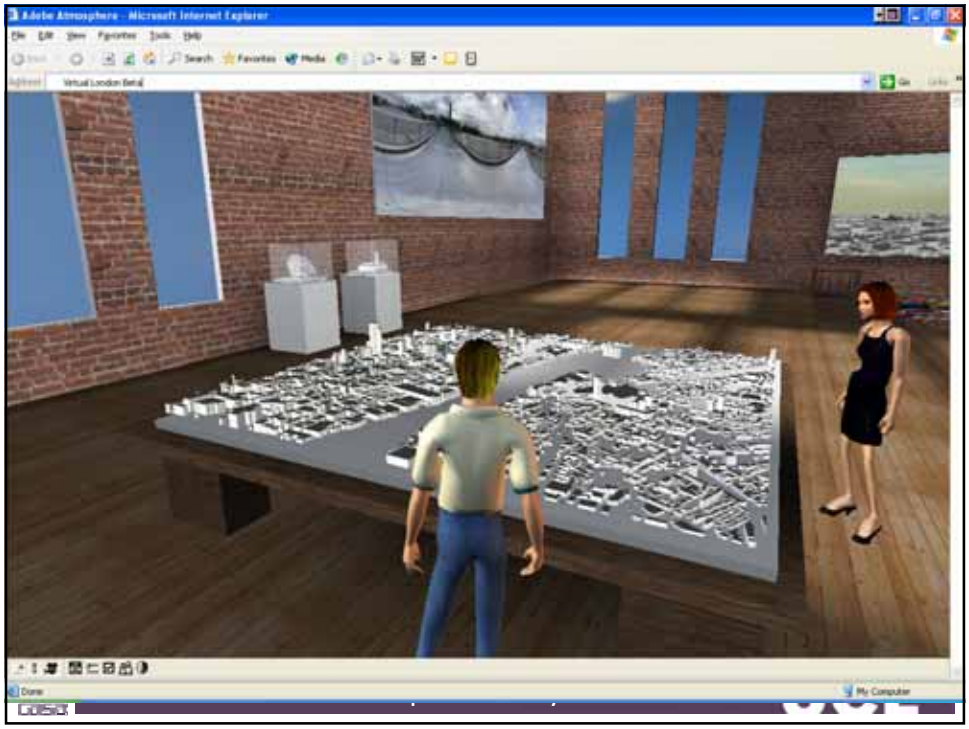


movie

Moving it into related media

Into games engines, virtual worlds, and into back into the material world by printing the model e.g.

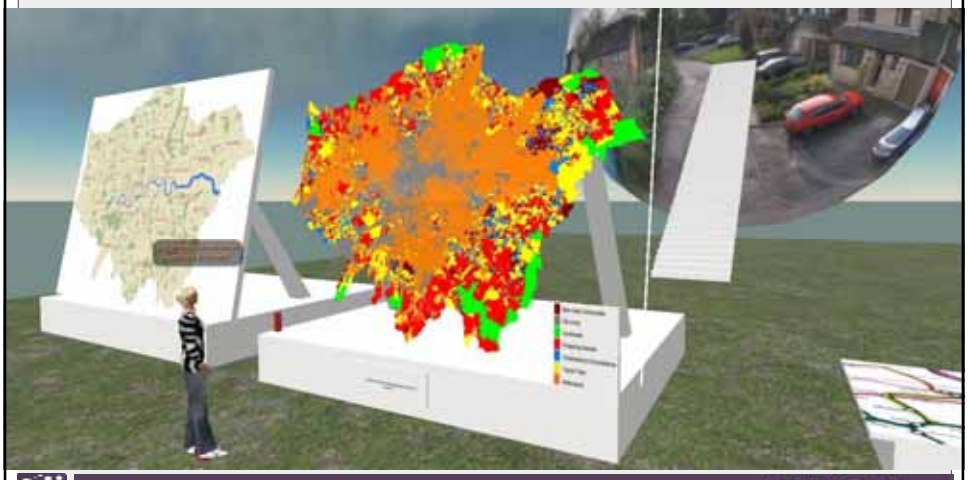
We can show a movie of this



alysis

UCL

Our recent forays are into ***Second Life*** where maps from our geodemographics project are being ported as 'geographic media' into these virtual worlds ……



Centre for Advanced Spatial Analysis

UCL

Let me show you some movies from our recent work with virtual worlds which we are rapidly developing for geographic information and virtual cities - worlds within world, illustrating the essential notion that geographic information, indeed any information can generate *insights into real worlds from dialogues in virtual worlds*

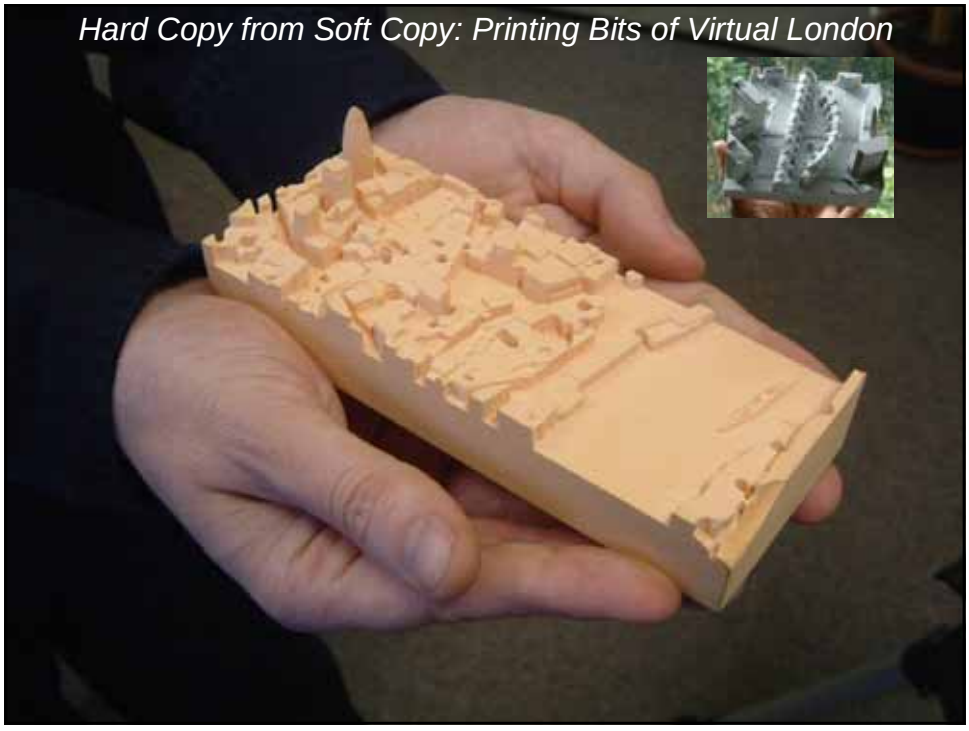
Second Life Basic Demo

Let me show you some movies from our recent work with virtual worlds which we are rapidly developing for geographic information and virtual cities - worlds within world, illustrating the essential notion that geographic information, indeed any information can generate *insights into real worlds from dialogues in virtual worlds*

Second Life Build Demo

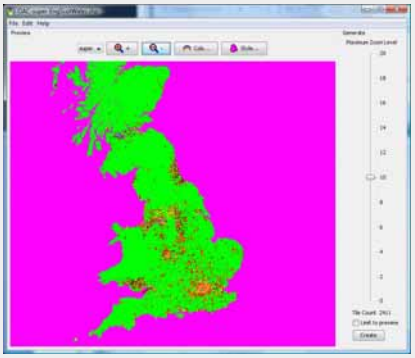
Centre for Advanced Spatial Analysis UCL

Hard Copy from Soft Copy: Printing Bits of Virtual London



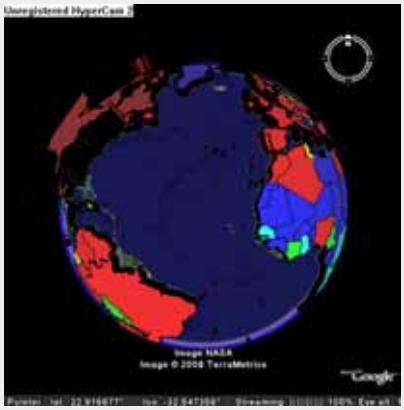
My fourth example: is all about representation in terms of data and maps and web 2 – how to present all of this, in Google maps and other open data

The Google Map Creator creates Google Maps websites from thematic data contained in shapefiles.It effectively layers your map on top of a Google Map or the Google Map



Centre for Advanced Spatial Analysis UCL

We can do the same sort of thing in 3D of course with ***GEarthCreator*** – the key is to convert the shapefiles to KML files – and there are many other maphacks using similar open map bases like ***Open Street Map***



From all of this we have devised an open resource for maps called ***MapTube***

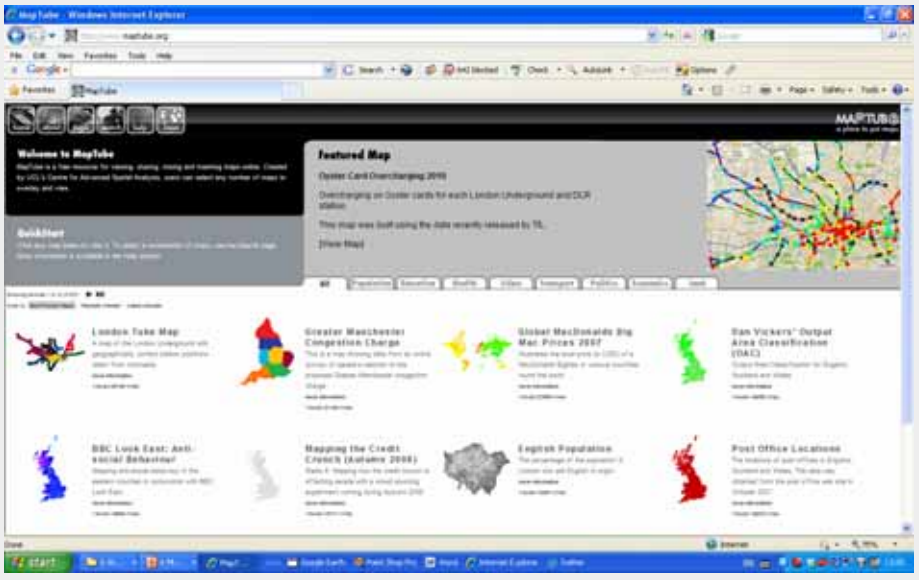
MapTube: a kind of ***YouTube*** + ***Napster***

Let me explain: every time someone downloads our software, there is a high probability they make a map.

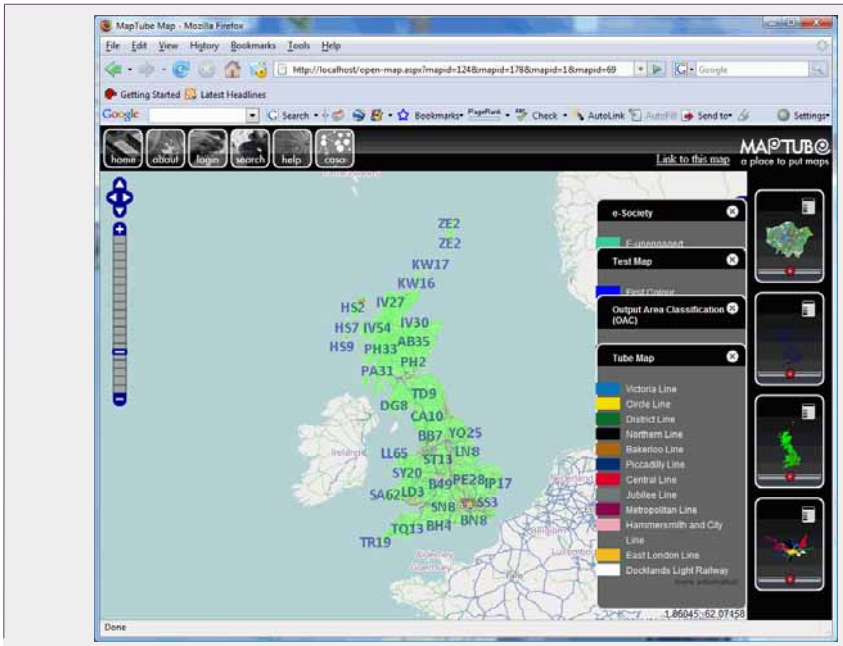
As it sits on a common base – a ***Google Map*** – if they create the map of some place and someone else creates another map of the same place, it would be nice if we or they could compare them as layers

However, in the UK map bases are copyrighted – you can done for copying OS map data and it is serious –

So we ask the user not to put their map created from our software on our site, but to give us their URL where their map is and thus ***MapTube*** is a bunch of pointers to URLs - this is what it looks like with demo



www.maptube.org

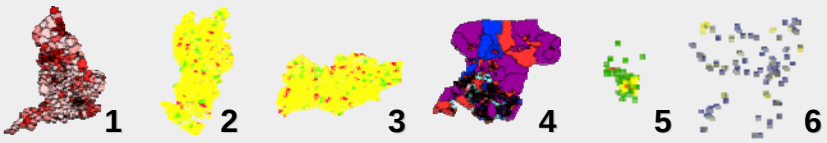


Centre for Advanced Spatial Analysis

UCL

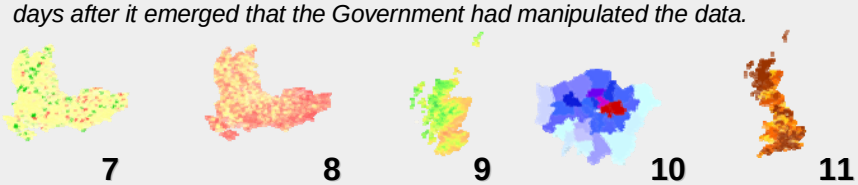
Here are some of the user map data in/on **MapTube**

MAPTUBE a place to put maps



1. Knife Crime Update, **2.** SC IMD Score, **3.** SEC IMD Score, **4.** PCT Obesity, **5.** NO_2 Bristol, **6.** AGFC Wildlife

The data behind the knife crimes map (1) has been in the news the last few days after it emerged that the Government had manipulated the data.



7. Southeast IMD, **8.** Southeast IMD (LSOA), **9.** Wild Land Quality Scotland, **10.** NSSeC L8 (never worked)%, **11.** CO_2 index

Centre for Advanced Spatial Analysis

UCL

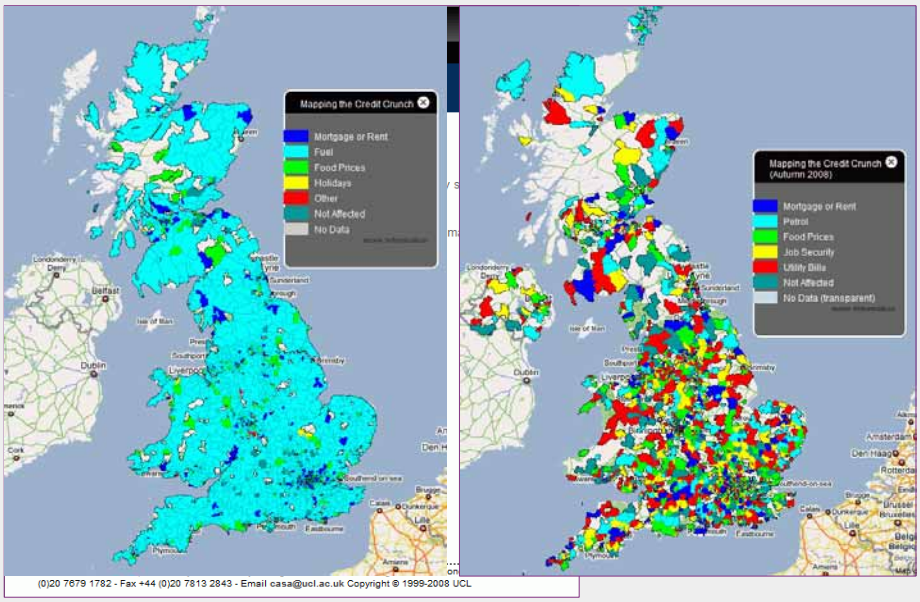
<u>Pulling pictures</u> – pulling spatial data – crowd-sourcing

We have turned all this around and basically used the system to record spatial responses to topical questions

We broadcast the questions through TV and radio and then ask users to respond and key in their post code – 7 digit in UK but actually only record postcode sector – first three or four digits

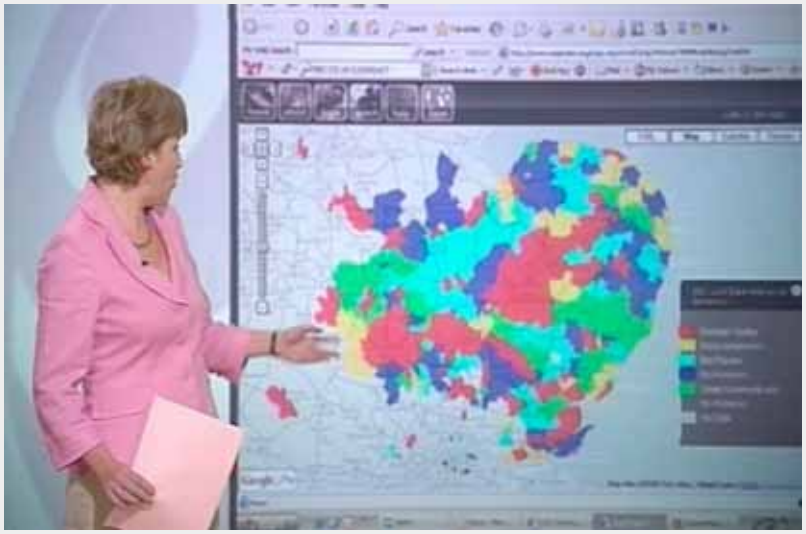
Then our server issues a request to scan the continually refreshed database and rebuilds the map on the fly so to speak, every half hour, using GMapCreator etc

We have so far looked at the credit crunch, antisocial behaviour and the Manchester road pricing proposal



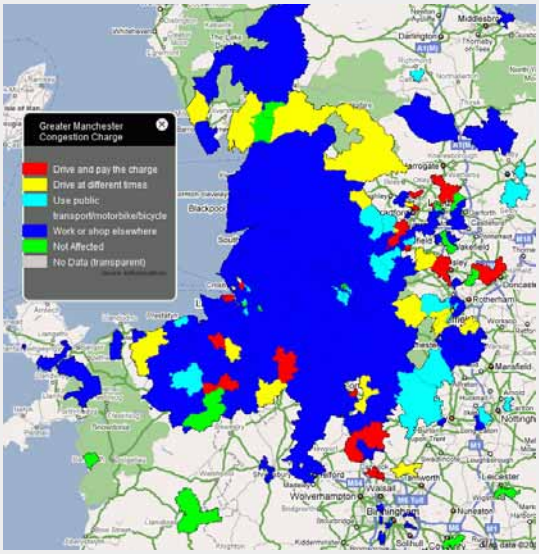
http://www.casa.ucl.ac.uk/

BBC Look East: Anti-Social Behaviour

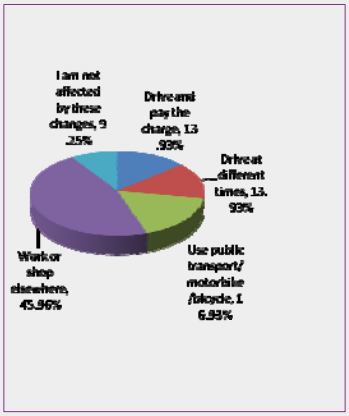


http://www.maptube.org/lookeast

Manchester Congestion Charge



15,902 responses
October to December 2008



My fifth and last example: is representational again – how to present all of this, in Google maps as we have seen, and also in terms of motion, sensing

Our EPSRC CAPABLE project involves us in representing and modelling movements at the small scale, pedestrian movements, children walking to school, and using energy.

The project is about communicating these ideas to ourselves and to the wider constituency that is involved in these issues – walkability, obesity, safety.

I have backups as the network here runs slow but let me try to show you these examples from our web site, first www.casa.ucl.ac.uk

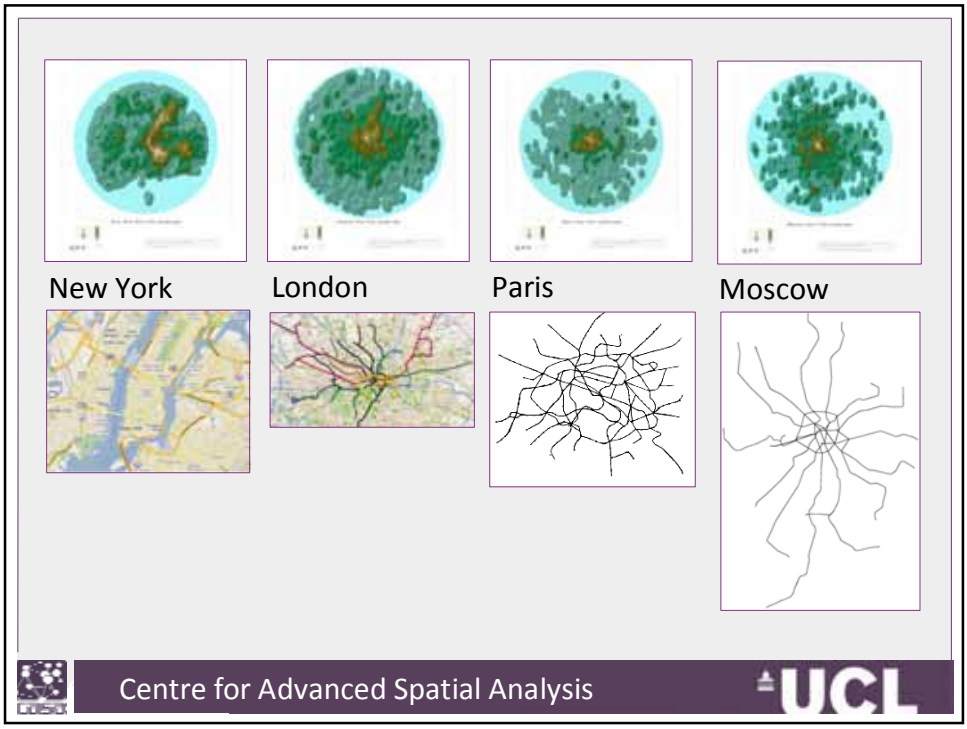
But in case I can't…

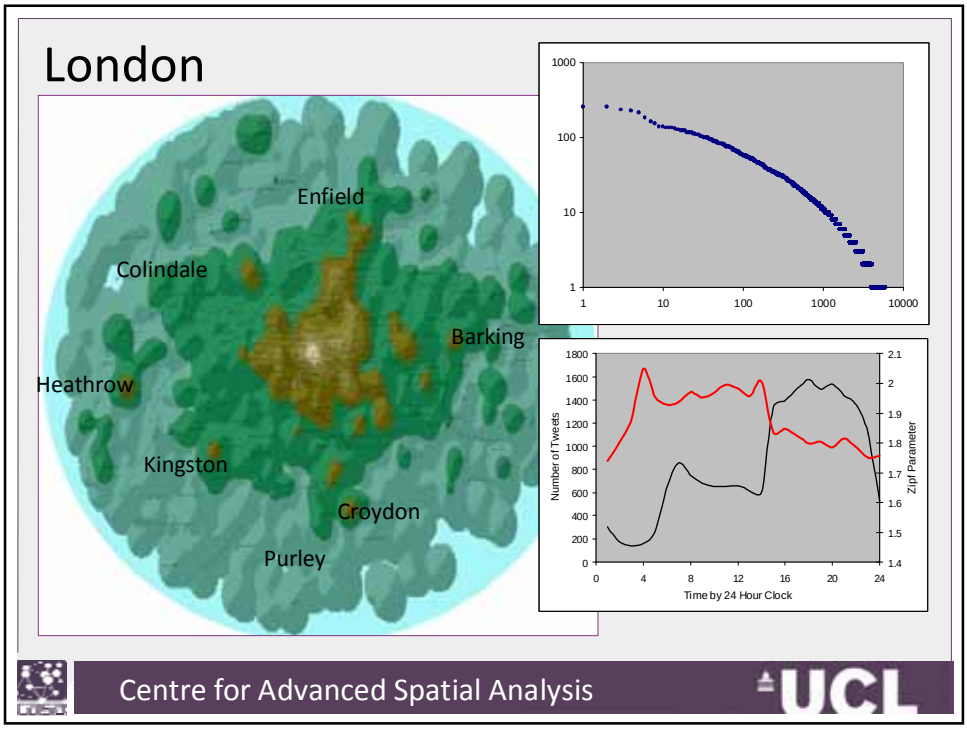
Enough of me and onto the real stuff…how do we do this stuff, how do we present and communicate it to ourselves and to others.

And like everyone else we are working with geocodes data from social networks

Many traffic data sets – Oyster card data, bikes data, taxi cab GPS and so on but here we will look at Tweets – the Tweet-o-Meter




New York
London
Paris
Moscow
Centre for Advanced Spatial Analysis
UCL


London
Enfield
Colindale
Barking
Heathrow
Kingston
Croydon
Purley
1000
100
10
1
1
10
100
1000
10000
1800
1600
1400
1200
1000
800
600
400
200
0
Number of Tweets
2.1
2
1.9
1.8
1.7
1.6
1.5
1.4
Zipf Parameter
0
4
8
12
16
20
24
Time by 24 Hour Clock
Centre for Advanced Spatial Analysis
UCL

A lot of material I know,
but to paint a picture, an impressionism

Questions, Discussion?

www.complexcity.info

Centre for Advanced Spatial Analysis UCL