BIKEABILITY.DK
cities for zero-emission travel and public health

THURSDAY, DECEMBER 2ND, 2010, COPENHAGEN

Visualising & Modelling Local Movement

What We Are Doing in CASA

Michael Batty

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

Outline

- What We Do in CASA
- Modelling Cities: Morphologies, Movement, Location: Social Physics, Microsimulation, ABM, etc
- Four Broad Areas: Modelling, Visualising, Mapping, and Sensing
- Our Projects: From Blue Skies to Fairly Applied
- Recent Examples: Sensing, Spreading, Visualising
- A Focus on ABM, Pedestrian Modelling and BIKEABILITY: The London Bikes Project

What We Do in CASA

We are a fairly eclectic group focussed on using formal methods, models, computation in relation to cities – we tend more to the cities side being architects and planners and engineers than to math/computation per se

But we have a lot of programmers and applied maths people as RAs and Co-investigators in our projects

We work to a strong sub-theme of the complexity sciences

We started 15 years ago are interdisciplinary, cross disciplinary but we are embedded as one of the 7 units that comprise the Faculty of the Built Environment – i.e. the Bartlett School

Modelling Cities:

Our models draw from several traditions – primarily social physics which involve things like nonlinear dynamics, scaling, reaction-diffusion and so on, and we operationalise our models using ABM, microsimulation, aggregate econometrics and so on

Our focus tends to be at the district level up – i.e. neighbourhoods in cities up to metro regions like Greater London, but with recent extensions to global dynamics

There are also pressures in our work to extend down-scale because of our interests in sensing and new data sources

Three Broad Areas: Modelling, Visualising, Mapping, and Sensing

We have projects in all these areas and I will catalogue these in a minute before I describe a few of them

Our core technologies used to be GIS and still are but we extend to all sorts of applications such as CAD, multimedia, Web 2.0 applications and so on

I have not mentioned data but we are immersed in large spatial data sets – and have strong interests in open data, public data and so on; obviously in map data, and increasingly in sensing data

Our Projects: From Blue Skies to Fairly Applied

Modelling:

ARCADIA (EPSRC) Climate change in Greater London (Tyndall)

SCALE (EPSRC) – the impact of rapid changes in energy costs on movement dynamics in cities (with CS and Transport)

Enfolding: Modelling and Visualising Global Dynamics – in trade, migration, development aid, etc (with ….)

Mechanicity (ERC) – modelling cities and their morphology using allometry and network science, with a focus on energy

Mapping:

GENeSIS (ESRC) – generative spatial modelling and mapping (with Leeds) using web 2 style mapping – building new kinds

of GIS infrastructure for social scientists. This work is extending into sensing and into fine scale pedestrian modelling

NeISS – an add-on to GENeSIS from JISC involving mapping

Visualising:

To an extent, all our projects involve visualisation as this is a major way of reaching out to stakeholders as well as embracing the complexity of our simulations and delivering our science to others

Sensing:

TOTEM (EPSRC) – tagging objects with codes – building memory into the built environment (with …..

COSMIC (ERA-Complexity-Net) – a pilot network on spatial dynamics in cities at the fine scale involving sensing

Examples: a focus on Sensing & Visualising

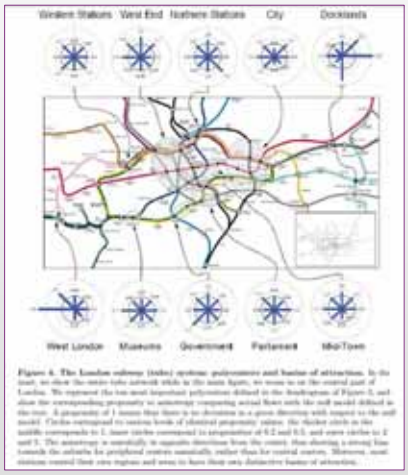
I am going to pick five modest projects from our set and look at these – they all involve the four areas we are working in modelling, mapping, visualising and sensing but they are more geared to the latter two areas; and they are quite current and represent our way forward: I will look at

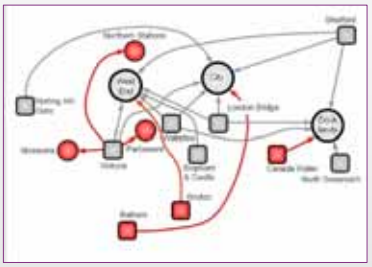
- Network Data in the COSMIC project
- MapTube – web mapping and crowd-sourcing
- Spatial Analysis of Urban Activity using Twitter data
- Early and Current Projects on ABM & Pedestrian Modelling
- Measuring Online Demand and Supply for Transport (the London Bikes Project)

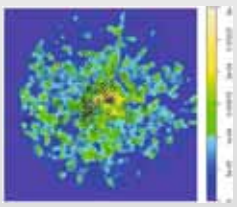
Network Data in the COSMIC project

CASA Telecoms

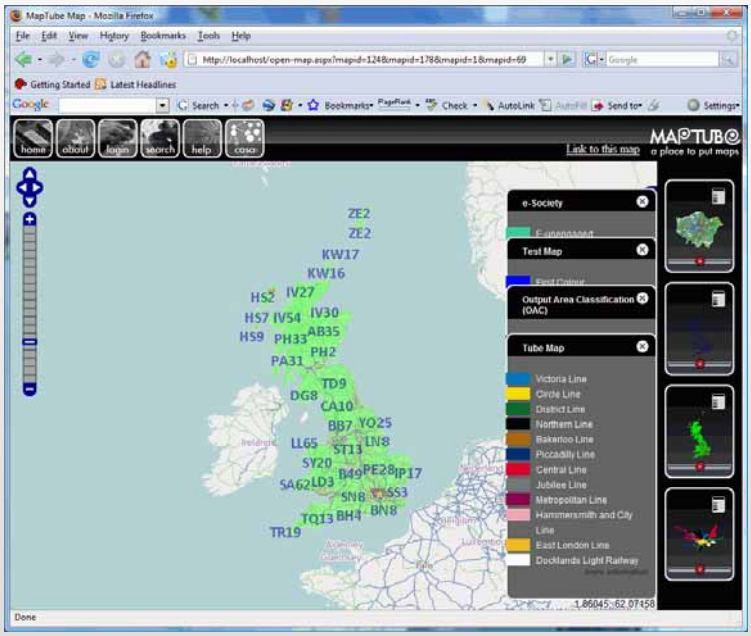
CASA Subway Data – London Tube, and London data generally







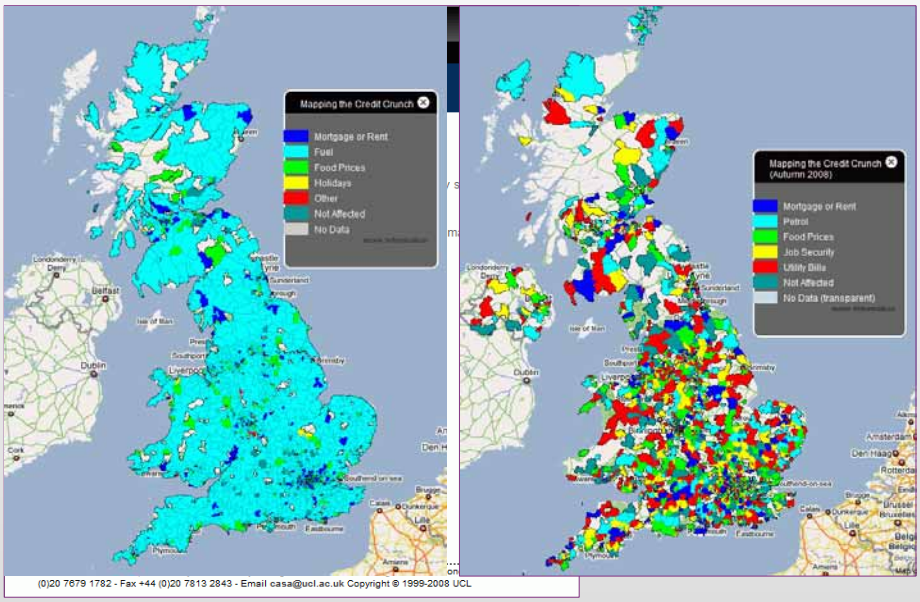
MapTube – web mapping and crowd-sourcing



Tooth courtesy of
Johan Lundin
Biomedical Informatics Research Group
Department of Oncology
University of Helinski
http://www.webmicroscope.net/

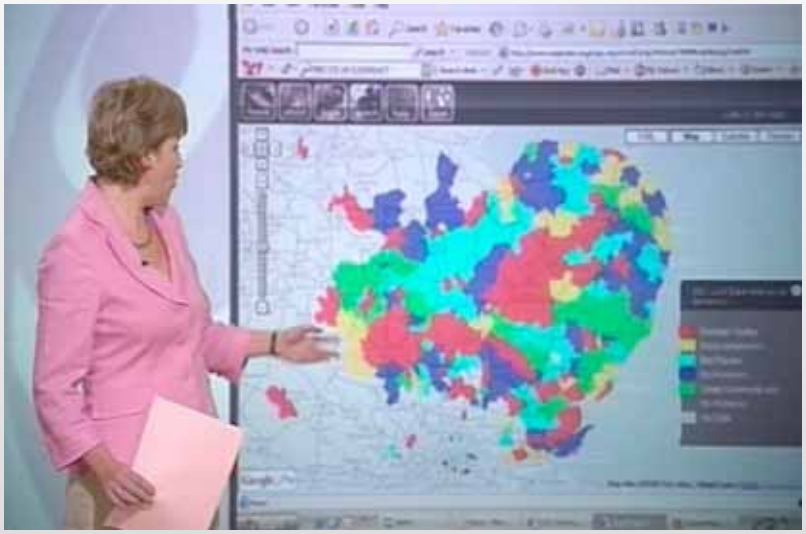
The Kremer Collection
http://www.thekremercollection.com/

http://chs75.harvard.edu/manuscripts/



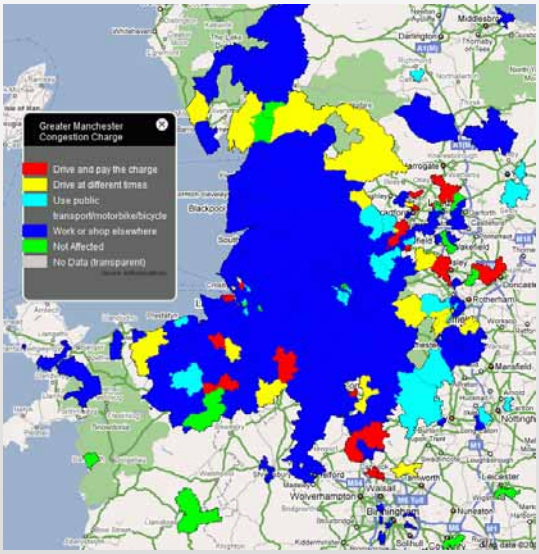
http://www.maptube.org/creditcrunch/

BBC Look East: Anti-Social Behaviour

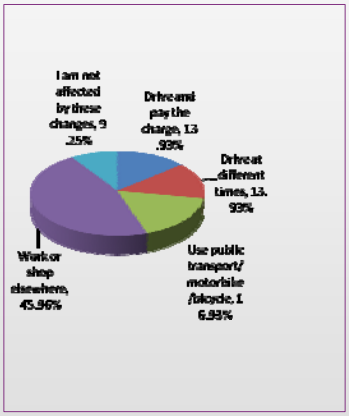


http://www.maptube.org/lookeast

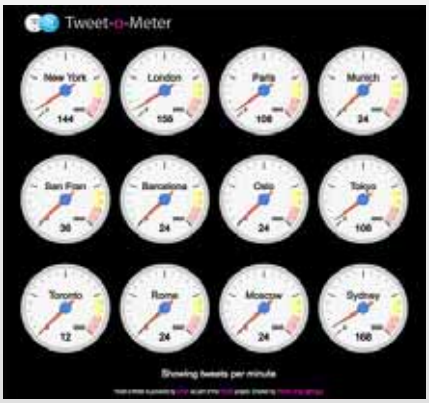
Manchester Congestion Charge

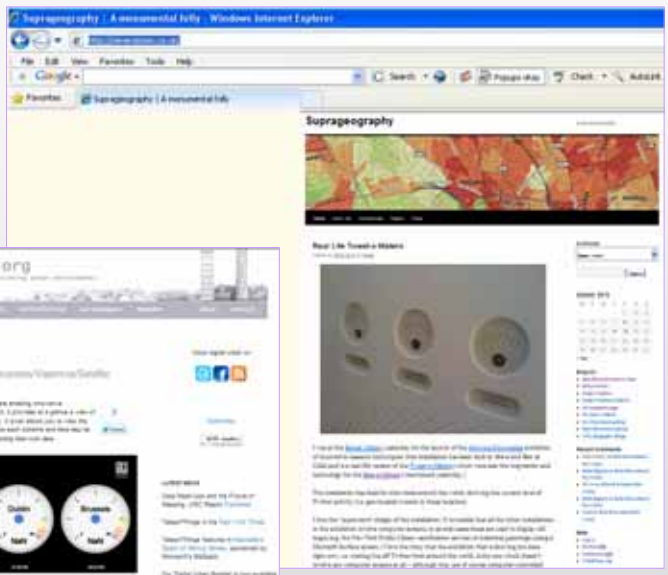


15,902 responses
October to December 2008



Spatial Analysis of Urban Activity using Twitter data





Centre for Advanced Spatial Analysis UCL

Tweets as Background Radiation about Dynamics in the City

UCL

Urban Tick

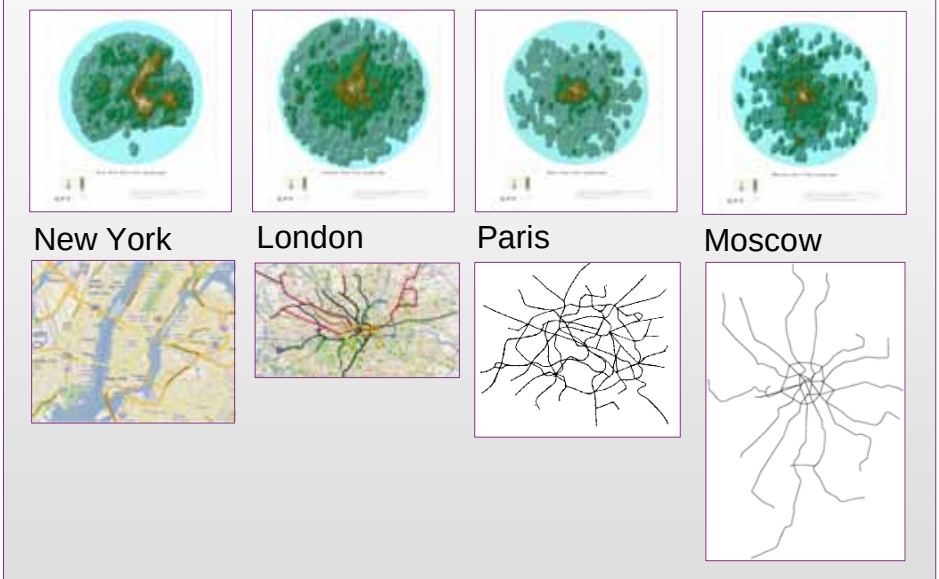
Urban Tick is a new blog which is written by Fabian Neuhaus who is studying rhythms and cycles in the city for his doctoral work. An important way of looking at cities is through the fast processes that define the functions of the urban environment of which local movement is key. Tracking individuals and relating their space time trajectories to their behaviours and the activities that they frequent and use is basic to the way cities are organised. We can begin to define spatial structures in terms of such movement and tracking individuals is fast becoming one of the ways in which such structures can be defined. Contemporary IT with embedded GPS is central to all of this and Urban Tick seeks to record what is moving and shaking this fast developing field .

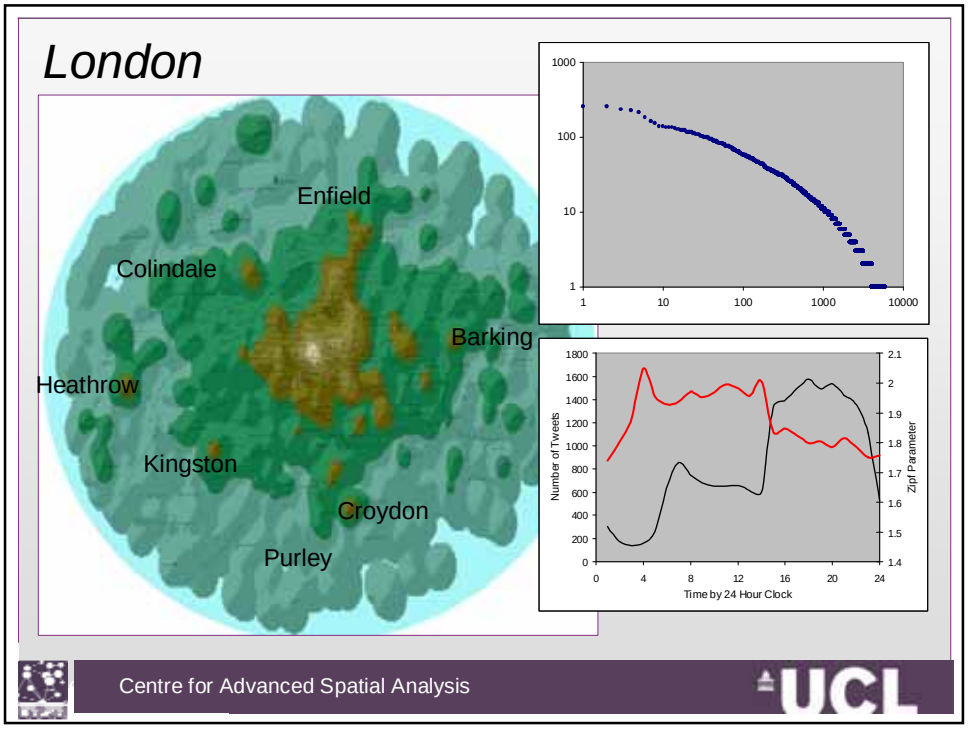
http://urbantick.blogspot.com

About this blog

Cycle studies are the science of everyday life, as normal as it gets. Its focus is the daily routine, with its habits and rhythms as they occure in most citizens' lifes. It is the power of the normal that brings stability and the routine that ensures security. But is is the cycles's dynamic of flow and continuation that prevents life from freezing.
Cycles therefore stand for stability but are at the same time the engine of change.

With this blog the research on cycles and rhythms will be embedded in the most recent developments in technology, covering a range of areas with a focus on space-time related technologies.



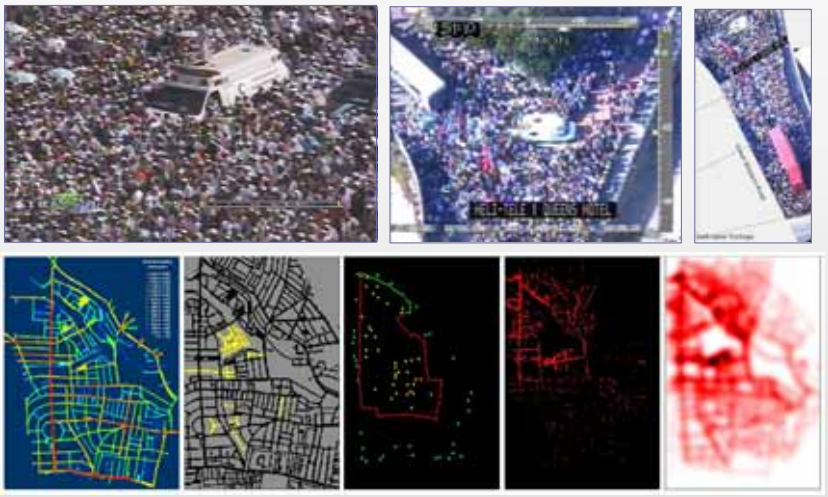


Developing Agent-Based Models for Simulating Movement – Pedestrian Modelling

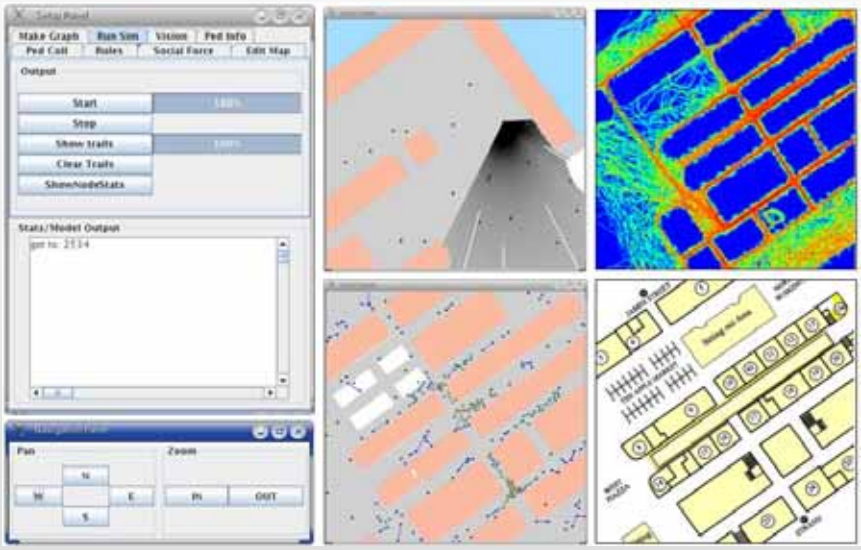
We have looked at three projects: two in CASA on the Notting Hill Carnival and the Covent Garden Entertainment Hub and one from Anders Johansson now in CASA from his time in Dresden and ETHZ with Dirk Helbing

Anders is now working on GPS tracing of movements in central London and we are planning some work on building an epidemics model of spreading diseases like the common cold in enclosed transport environments like the Tube system.

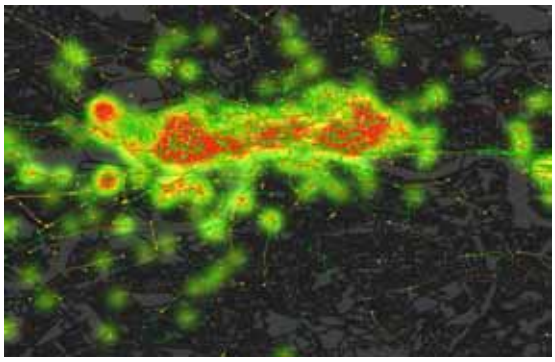
Here are some of these examples

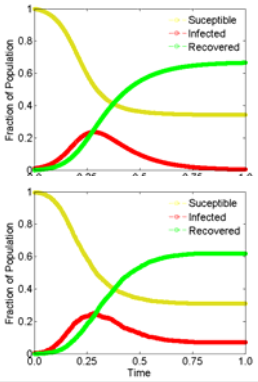


Above: Crowd Scenes and Emergency Vehicles at Hajj and in Notting Hill: Below: Our ABM of the Notting Hill Carnival



John Ward's ABM of Tourists & Shoppers in Covent Garden





Ander's Johannson's Epidemic Model of Central London based on GPS tracks from Courier Data
There is a very nice visualisation of this – animation – at http://www.ajohansson.com/london_epidemics.avi

Measuring Online Demand and Supply for Transport (the London Bikes Project)

Scraping Data: The London Bikes Experiment

Locally called Boris's Bikes

4200 bikes, 340 stations, access via online registration or by paying on a credit card at the local bike station – so all online data

City	Official Name	Installed	System	# of Bikes
London	Barclays Cycle Hire	July 2010	Bixi	4,300
Barcelona	Bicing	March 2007	Bikemi	4,200
Milan	Bikemi	December 2008	Bicing	1,100
Saragossa	Bizi	May 2008	Bicing	800
Girona	Girocleta	September 2009	TNT	100
Washington DC and Arlington	Capital Bikeshare	September 2010	Bixi	650
Montreal	Bixi	May 2009	Bixi	4,200
Minneapolis	Nice Ride	June 2010	Bixi	600
Denver	B-cycle	April 2010	B-cycle	350
Melbourne	Bike Share	June 2010	Bixi	400

Let's Visualise Them!

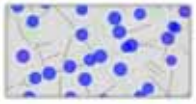
- Obtain the data from the operators' websites
  - Some provide XML/JSON/KML
  - Lots of Regex parsing
  - Velib-based systems require two stages
- Store it for analysis
- Stick it on a map
  - OpenLayers has some nice vector styling for points
  - OpenStreetMap-based background
  - Charts of historical trends via the Google Chart API

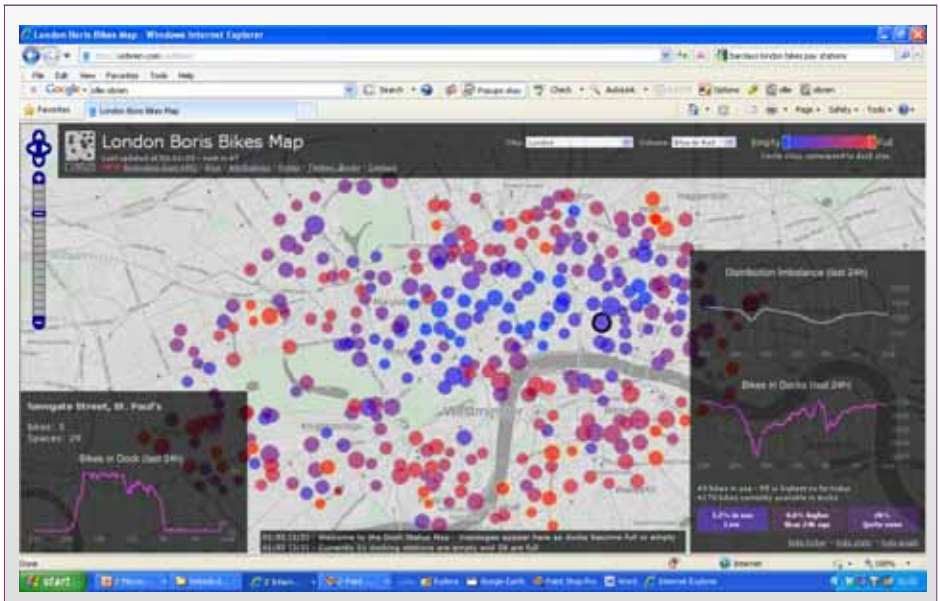
Bike-o-Meter
casa.ucl.ac.uk/bom

- 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 ☺

Bike/Dock Ratio

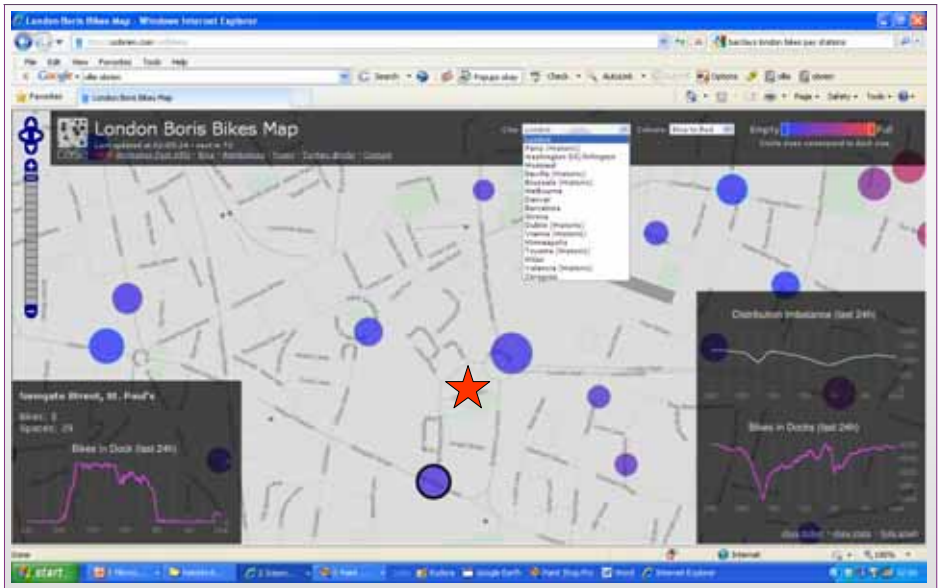
- No of bikes per 100 docks
  - Based on max availability at around 5am ("no" usage)
  - Averaged over a few weeks





Centre for Advanced Spatial Analysis

UCL

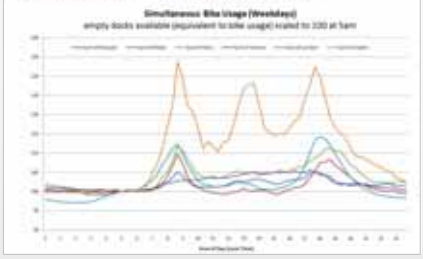


As yet no records of demand from people logging on, so no management capabilities, but could happen probably from an App based software but maybe from the server

Centre for Advanced Spatial Analysis

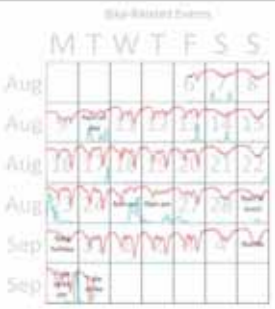
UCL

Weekday Use – 1. Europe ex-Spain

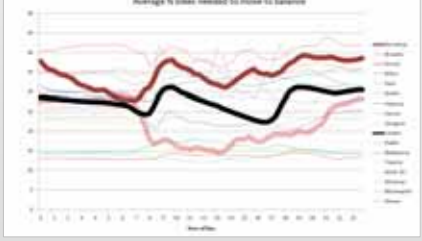


More Analysis

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



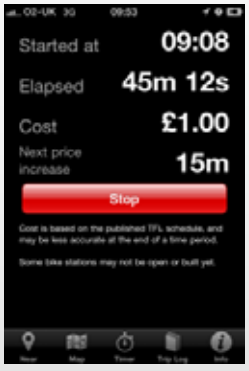
Redistribution Effectiveness



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 ☺

iPhone Screenshots



http://oobrien.com/vis/bikes/

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

m.batty@ucl.ac.uk

Centre for Advanced Spatial Analysis

UCL