School of Geography
FACULTY OF ENVIRONMENT

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Unlocking Agents

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In the beginning…

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GeoComputation

GeoComputation Conference Extended Abstracts

Extended Abstracts from the 1st International Conference on GeoComputation
University of Leeds
United Kingdom
17 - 19 September 1996

Sponsored by University of Leeds; Leeds School of Geography; GMAP Limited; GeoInformation International; Elsevier Science.

However, in many ways this is only the beginning of the extensive and broadly based development of a geocomputational paradigm that will over the next few decades grow in strength and expand in the breadth of applications as some exponential function of supercomputing speeds. The take-off has been delayed by **an inadequacy of high performance computing hardware, the lack of appropriate tools and technologies relevant to geography** that would need to be powered by supercomputers, and a deficiency in awareness and potential benefits to be gained. Suddenly the constraints have dissolved and we stand at the dawning of a new era of geocomputation.

ABM – what's that then?

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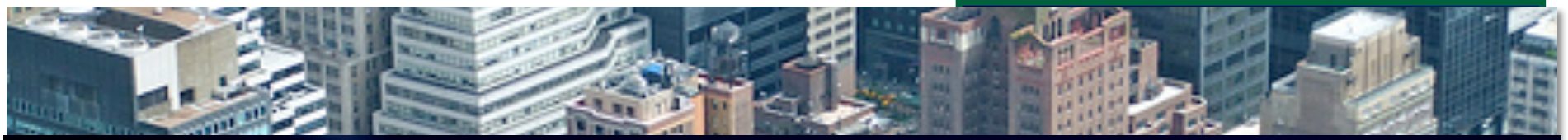

https://theconversation.com/how-big-data-and-the-sims-are-helping-us-to-build-the-cities-of-the-future-47292

Ethnic segregation

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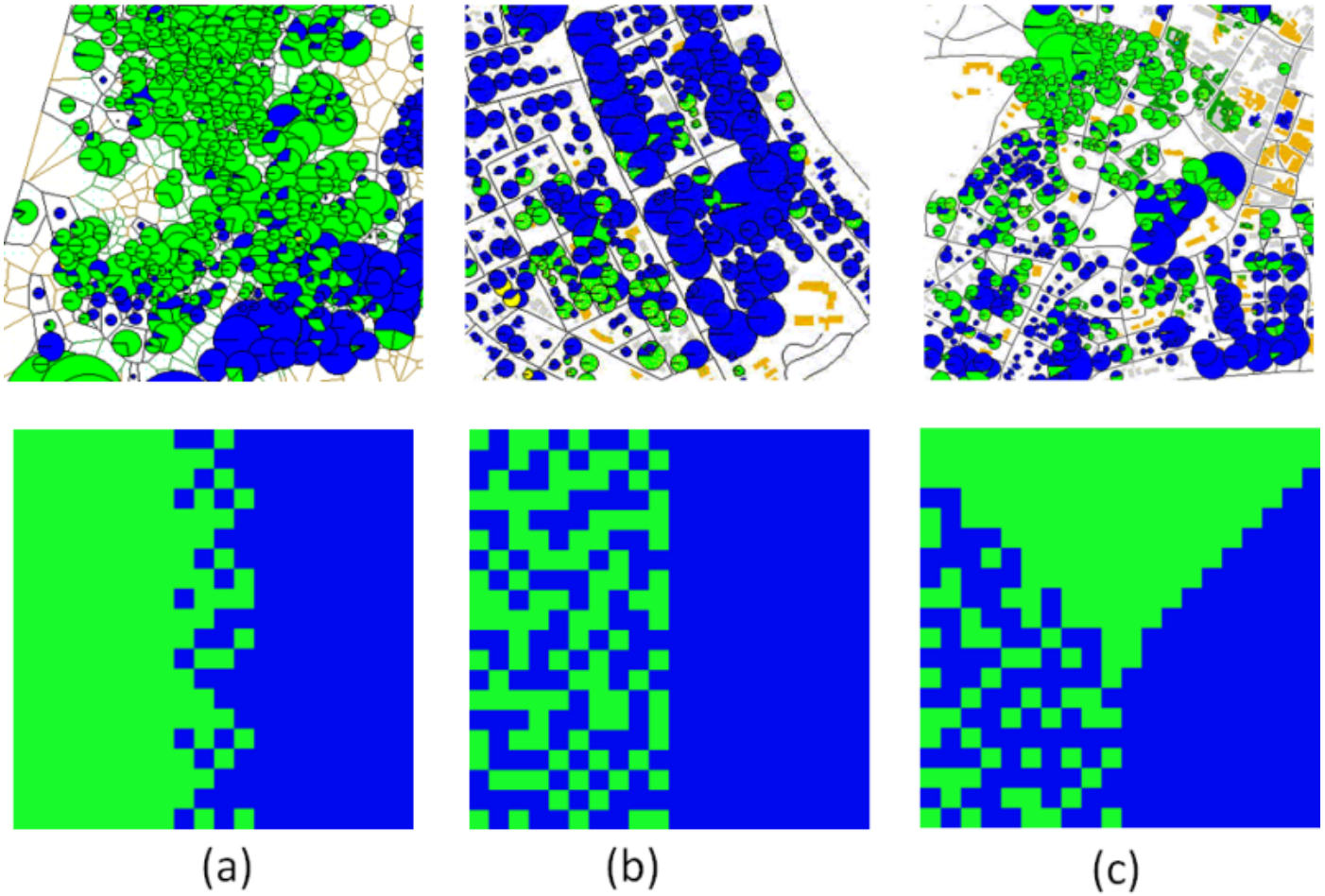

Hatna, E. and Benenson, I. (2002) Entity-based modeling of urban residential dynamics: the case of Yaffo, Tel Aviv. EPB: 491 - 512

Petrol price modelling

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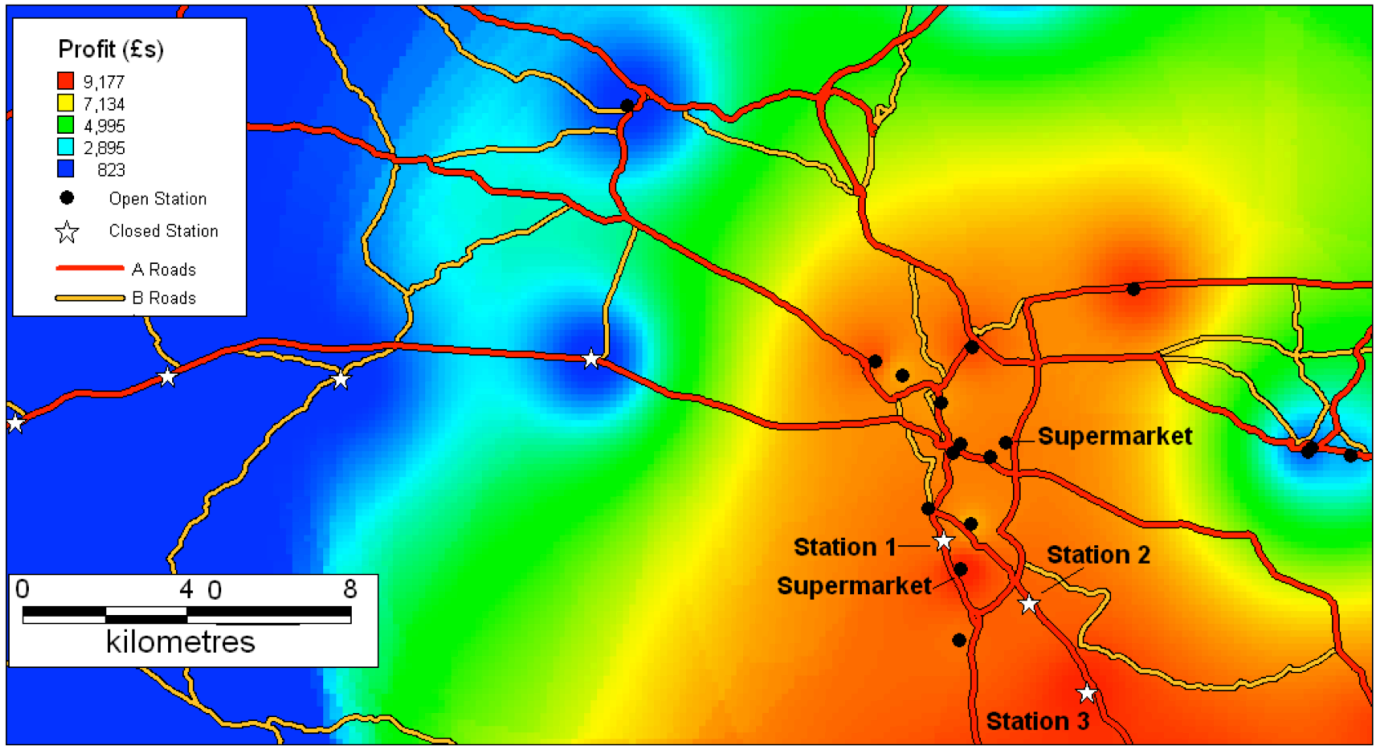

Heppenstall, A.J., Evans, A.J. and Birkin, M.H. (2006) Using hybrid agent-based models to model spatially-influenced retail markets. JASSS 9(3)

Simulating Crime

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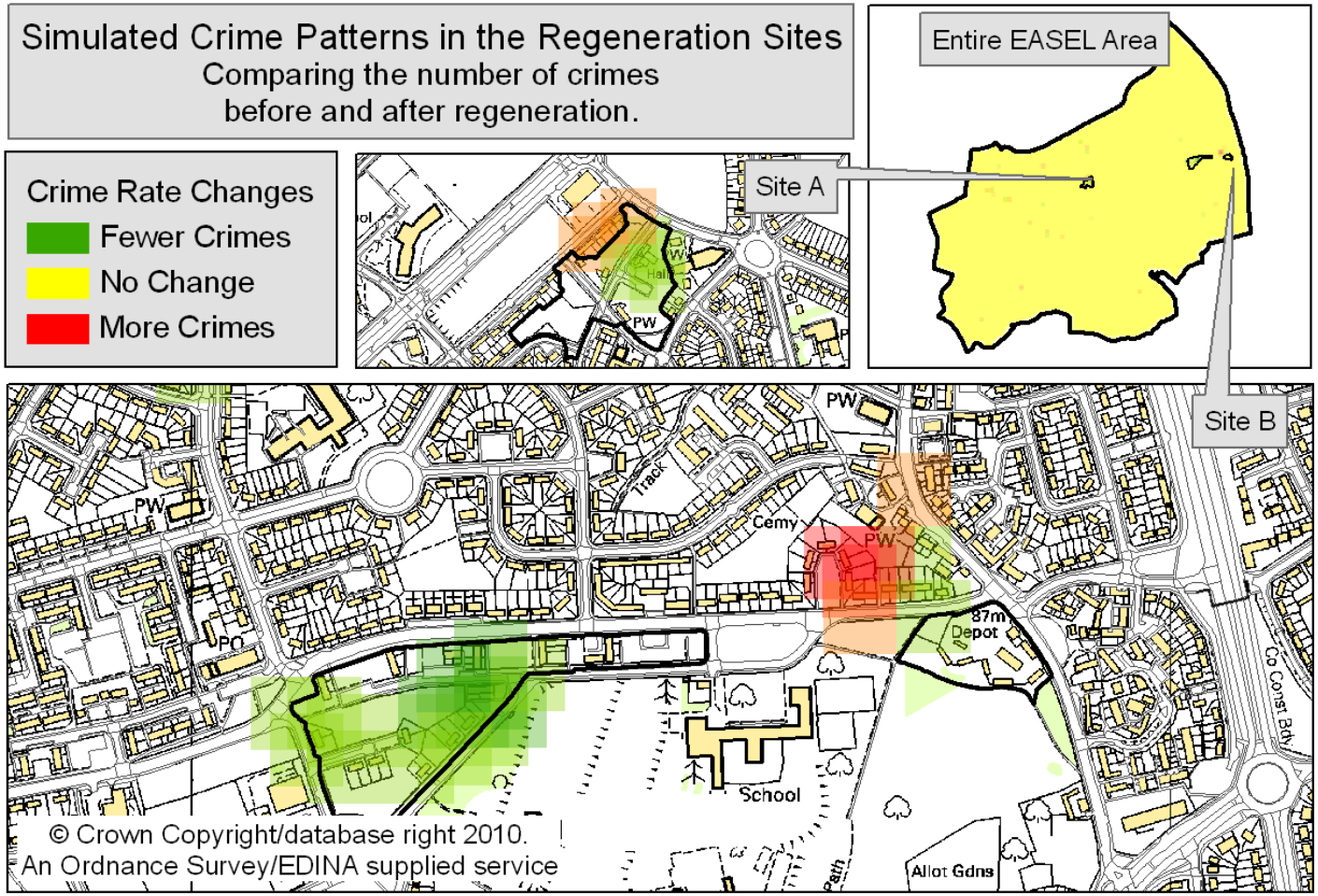

Malleson N, Heppenstall A, See L, Evans A, (2013), "Using an agent-based crime simulation to predict the effects of urban regeneration on individual household burglary risk" Environment and Planning B

Spread of Information and Movement

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https://www.youtube.com/watch?v=pIsu9wqKc3Q

Crooks, A.T. and Wise, S. (2013), GIS and Agent-Based models for Humanitarian Assistance, *Computers, Environment and Urban Systems*, 41: 100-111

Transport

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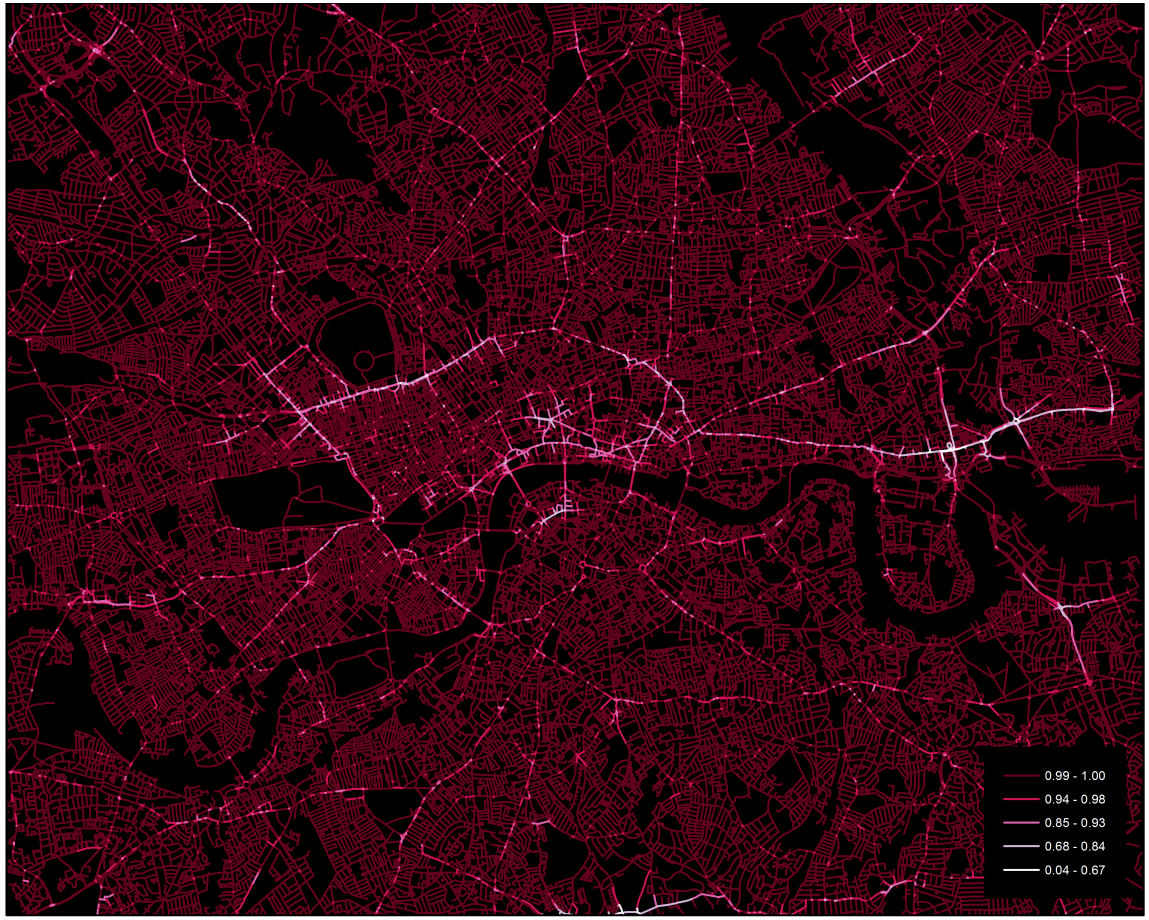

Manley, E., Cheng, T, Penn, A. and Emmonds, A. (2014) A frame-work for simulating large-scale complex urban traffic dynamics through hybrid agent-based modelling. CEUS 44: 27 - 36

Cooler application…

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And just because…

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Popular…

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Mesa: Agent-based modeling in Python 3+

build passing coverage 58%

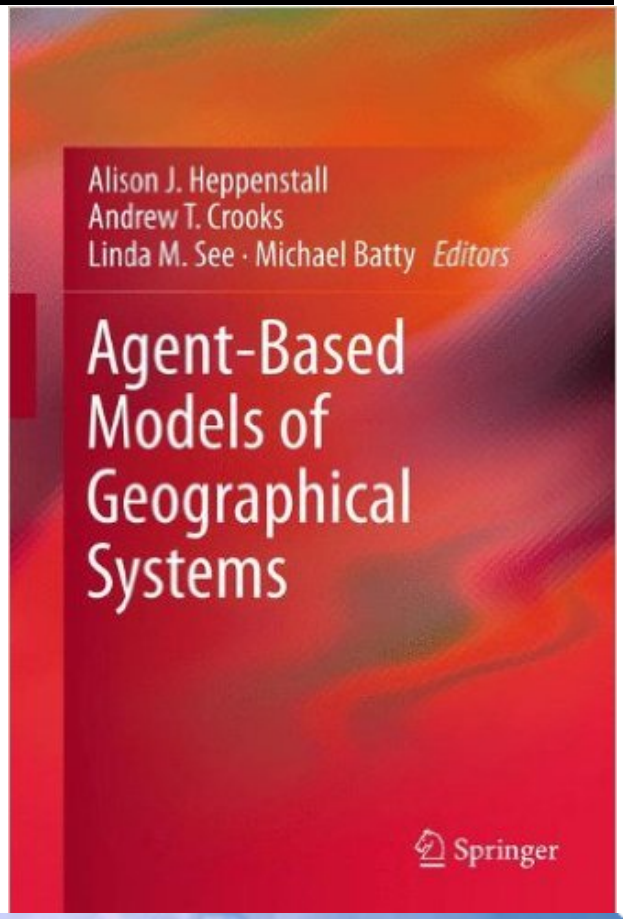
Mesa is an Apache2 licensed agent-based modeling (or ABM) framework in Python.

GeoMason: GeoSpatial Support for MASON

Evolutionary Computation Laboratory and the Center for Social Complexity

repast

SWARM



NetLogo

Towards the future

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http://improbable.io

SURF (Simulating Urban Flows)

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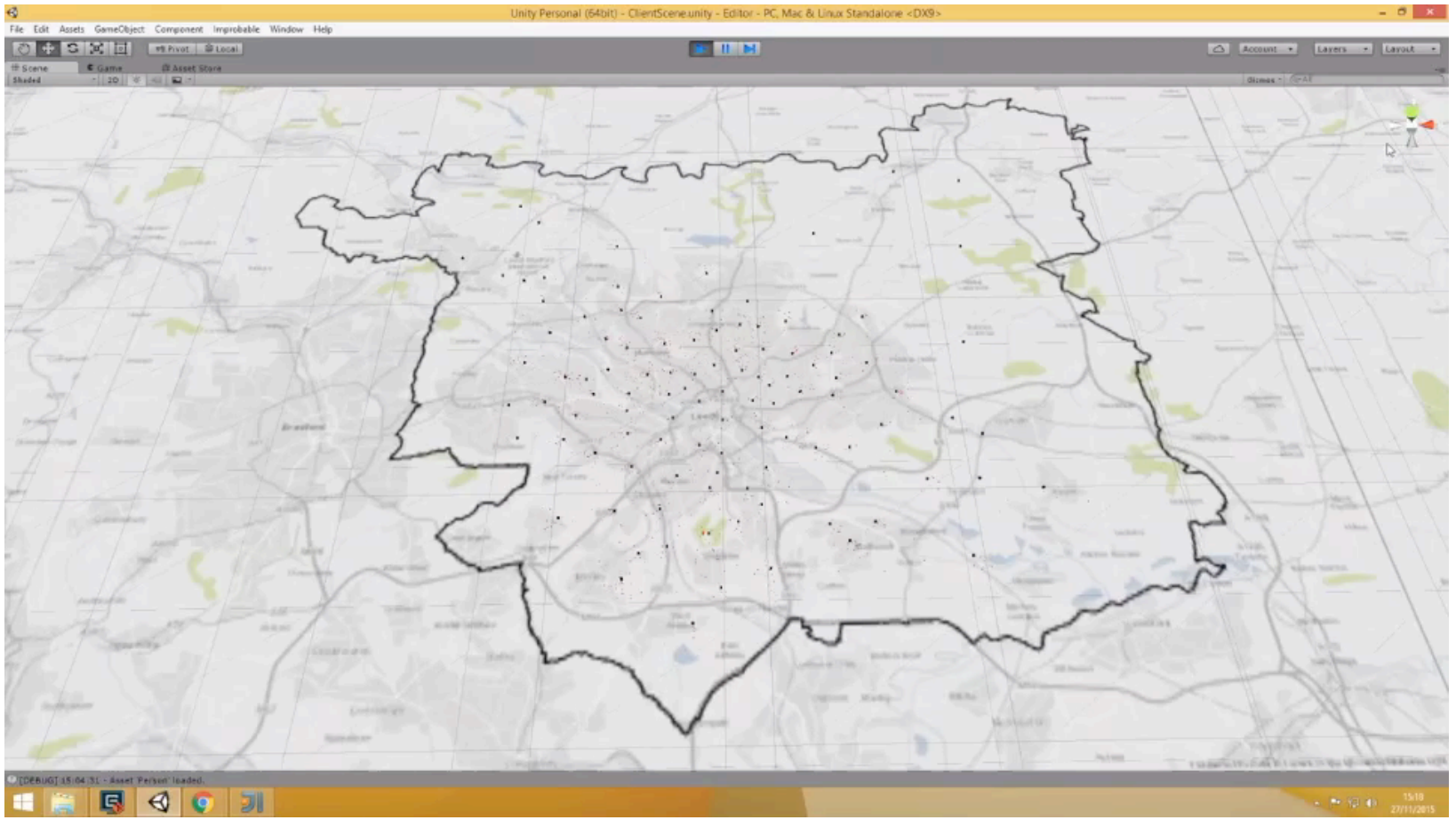

http://surf.leeds.ac.uk

In case the video doesn't work…

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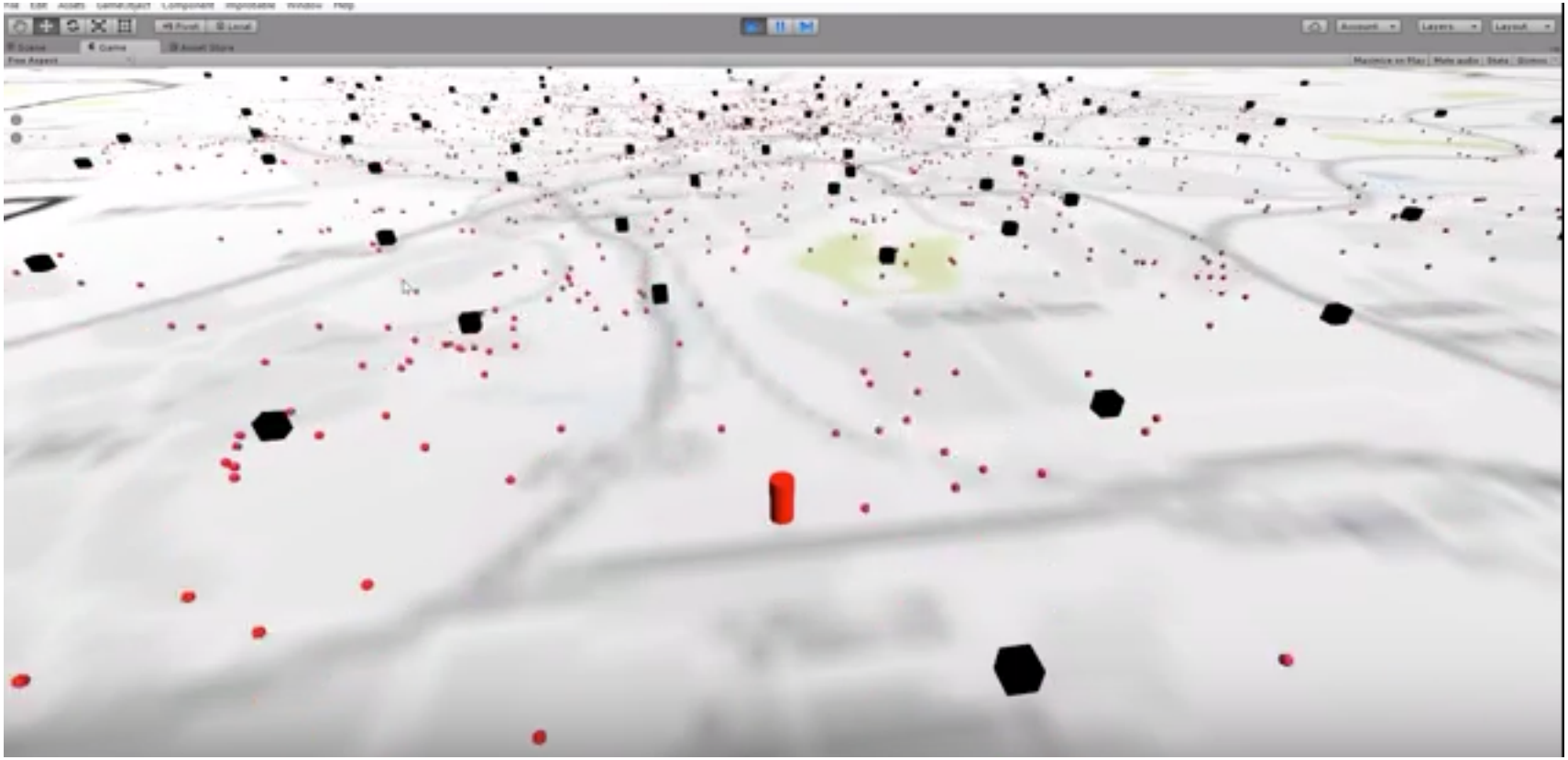

http://surf.leeds.ac.uk

But…

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Improvements: replicability and transparency

BUT what about:

Identifying, **representing** and **evaluating** key “behaviours”?

- What is it we are trying to evaluate? Behaviour? Processes? Something easy to quantify?
- What metrics should we use?
- What spatial scale? What time scale?

-No ABM in policy. Why?

- Poor evaluation, no confidence levels, abstract behaviour.

"Hey wait a minute! My Big Data analysis says I'm one gift short..."

http://www.equest.com/category/cartoons/cartoons-2013/

BIG
DATA

Data in Agent-Based Models

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Data required at every stage:

- Understanding the system
- Calibrating the model
- Validating the model

But high-quality data are hard to come by

- Many sources are too sparse, low spatial/temporal resolution
- Censuses focus on *attributes* rather than *behaviour* and occur infrequently
- Also need data from numerous scales (e.g. pattern oriented modelling; Grimm et al. 2005)

Understanding social behaviour

- How to estimate leisure times / locations?
- Where to socialise?

Crowd-Sourced Data for Social Simulation

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Movement towards use of massive data sets

- Fourth paradigm data intensive research (Bell et al., 2009) in the physical sciences
- “Crisis” in “empirical sociology” (Savage and Burrows, 2007)

New sources

- Social media
  - Facebook, Twitter, Flikr, FourSquare, etc.
- Volunteered geographical information (VGI: Goodchild, 2007)
  - OpenStreetMap
- Commercial
  - Loyalty cards, Amazon customer database, Axciom, mobile phones, Oyster cards, etc.

Ambient Populations and popular underground stations

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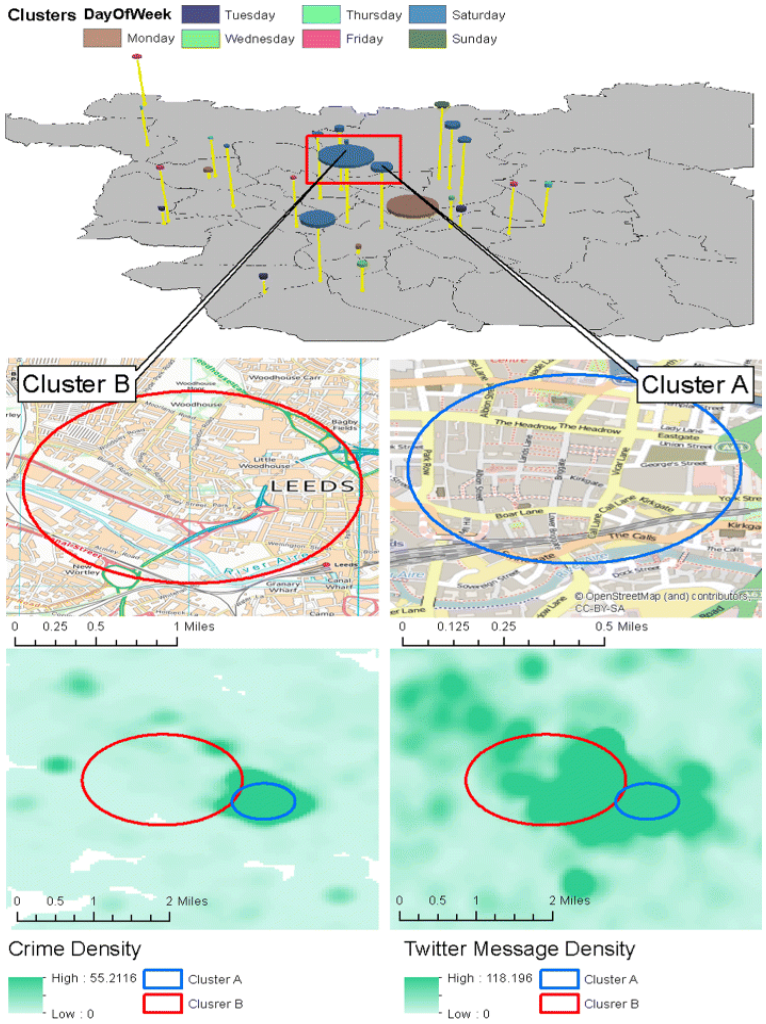

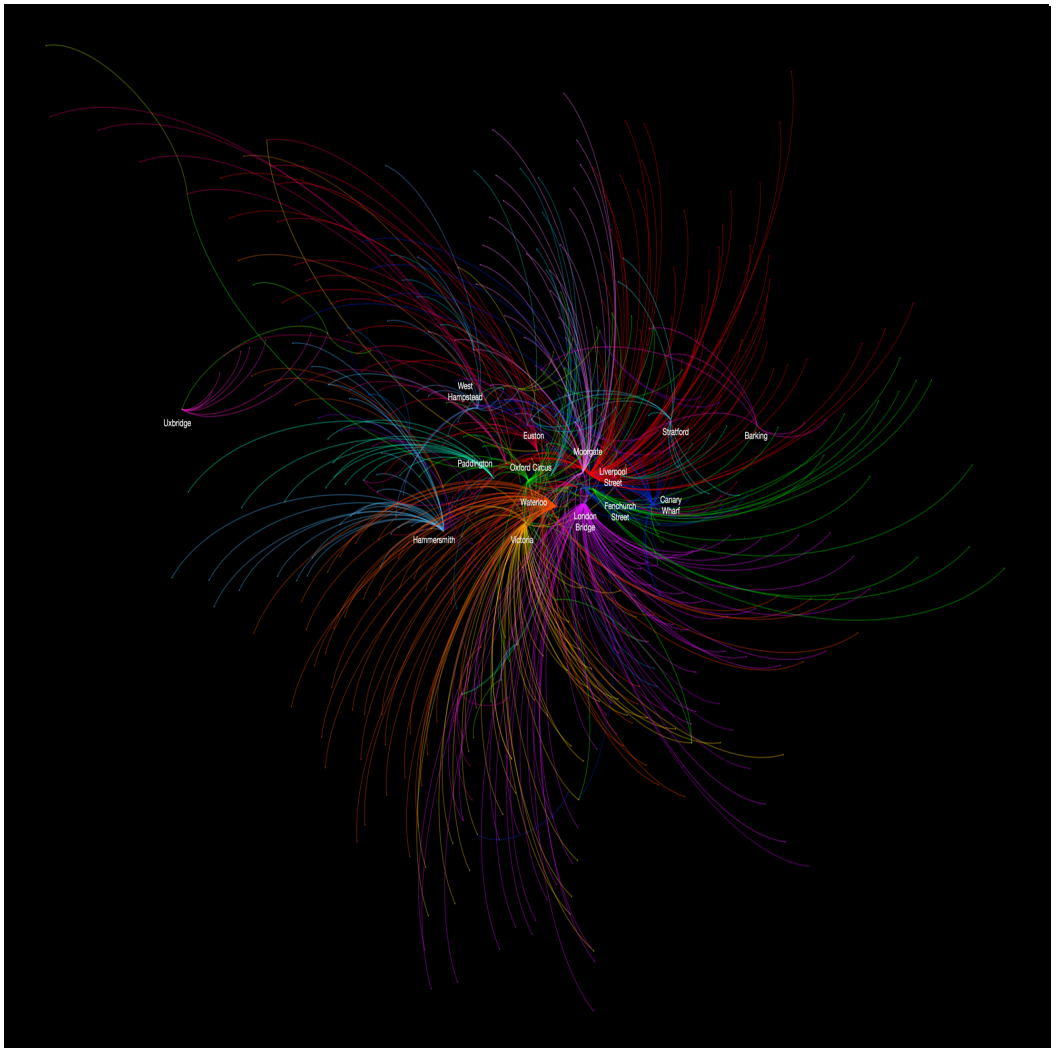

Malleson and Andersen (2015)

Acknowledgement: Ed Manley http://urbanmovements.co.uk

Problems with Big Data

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- Data handling and processing
- Analysis tools
- Bias: Which groups of people are absent from the data?
- Reliability: How accurate are GPS coordinates? Can you derive a person's intended meaning from short texts?
- Ethics…

Unlocking agents…unlocking big data (BD)

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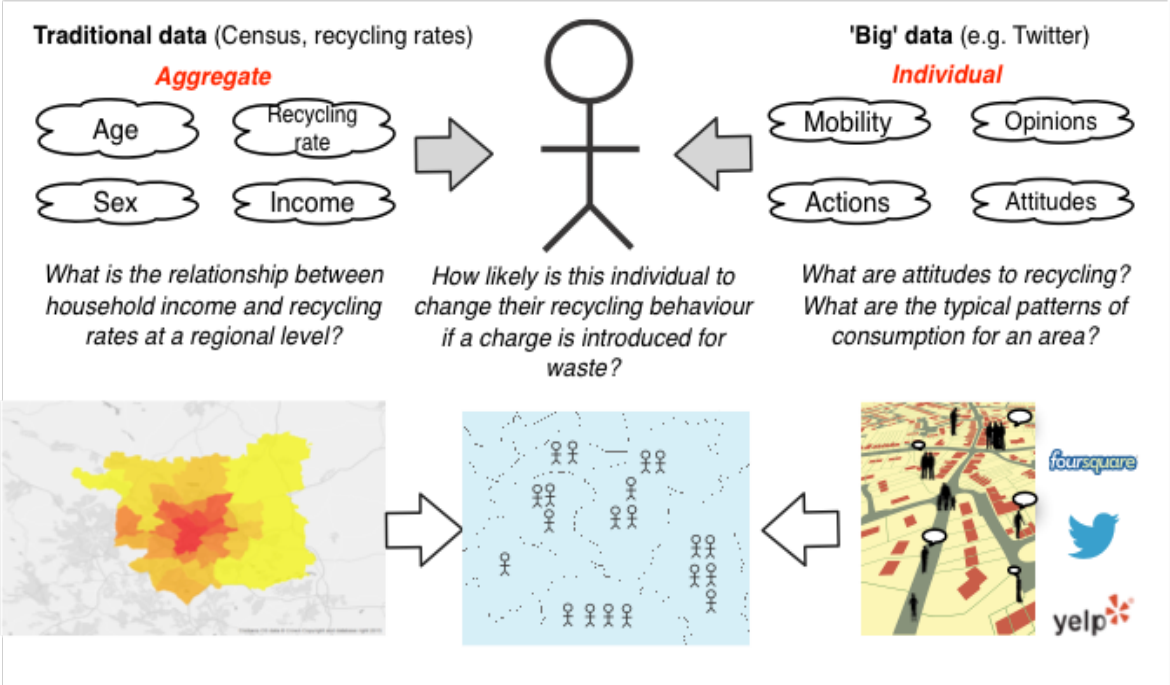

There is a need to exploit BD to unlock the potential of ABM, but also for ABM to leverage more out of BD. By building ABMs with BD, we can simulate society, across many application areas, in terms of who, where, what and why?

Only Geographers can save the world

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“So many of the world's current issues – at a global scale and locally - boil down to geography, and need the geographers of the future to help us understand them. Global warming as it affects countries and regions, food and energy security, the degradation of land and soils from over-use and misuse, the spread of disease, the cause and consequences of migration, and the impacts of economic change on places and communities. These are just some of the challenges facing the next generation, which geographers must help solve”.

Michael Palin, Guardian, 18/08/11

Skills? Knowledge?

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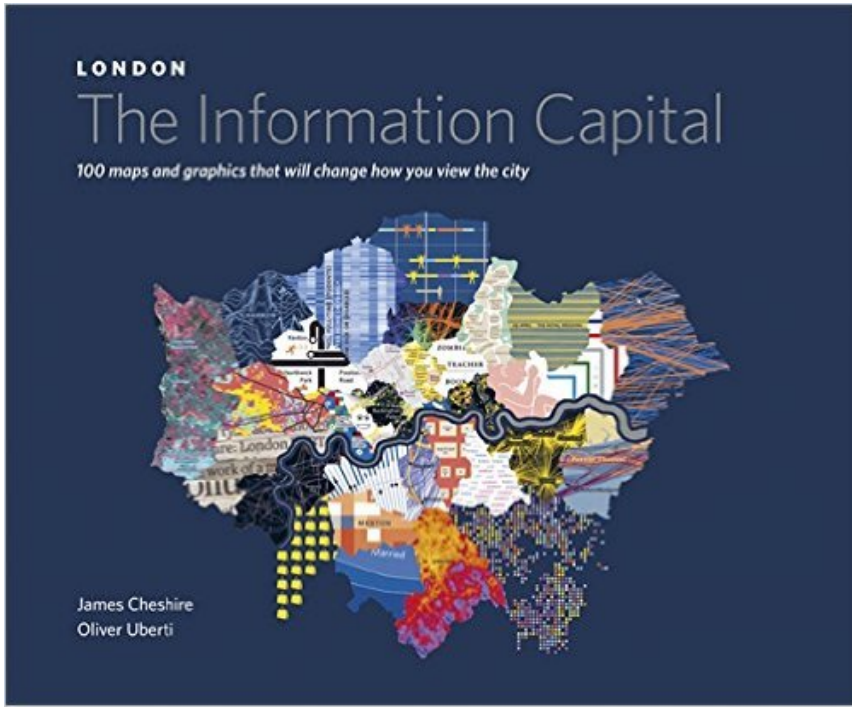
- Coding
- Statistics
- Web-GIS
- Infographics
- Complexity
- Philosophy (Ethics)
- Oh yes, and some Geography



How we teach: bottom-up…

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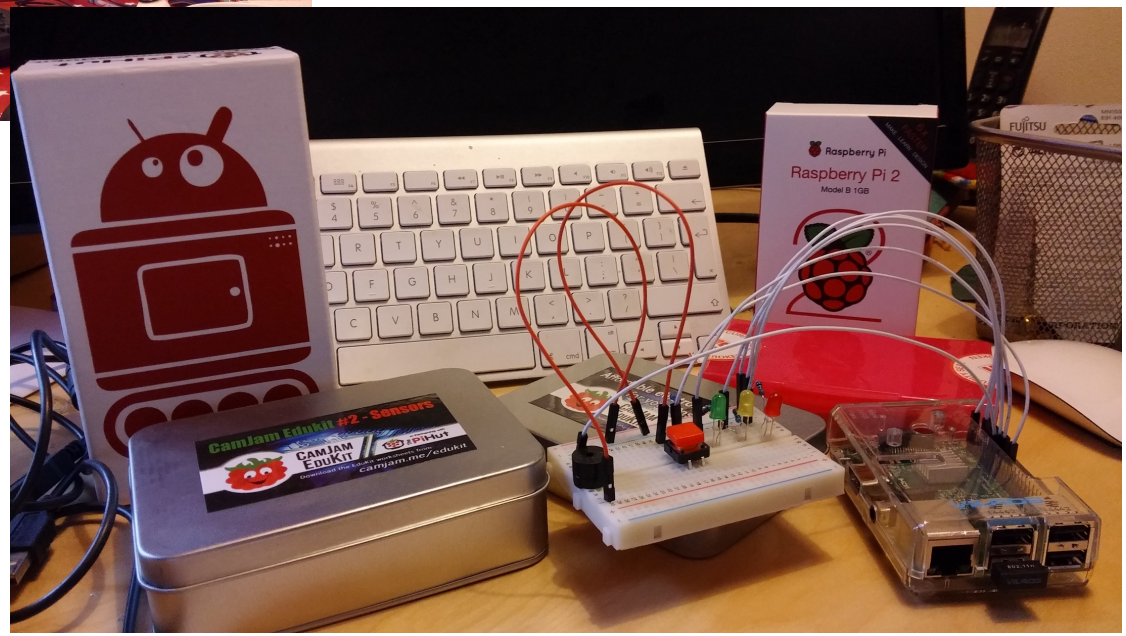
COMPUTING AT SCHOOL
EDUCATE · ENGAGE · ENCOURAGE
In collaboration with BCS, The Chartered Institute for IT



…and top down

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GEOG3150 - GIS, Geocomputation and Geoplanning - Semster 2

Home | Lectures | Practicals | Seminars | Project | Resources

Welcome to GEOG3150 Semester 2

This website is for Semester 2 of GEOG3150 - GIS, Geocomputation and Geoplanning.

Use the links above to navigate to relevant parts of the course. Also see:

- Course Outline
- Contacts

(Don't use Internet Explorer)

Reading List

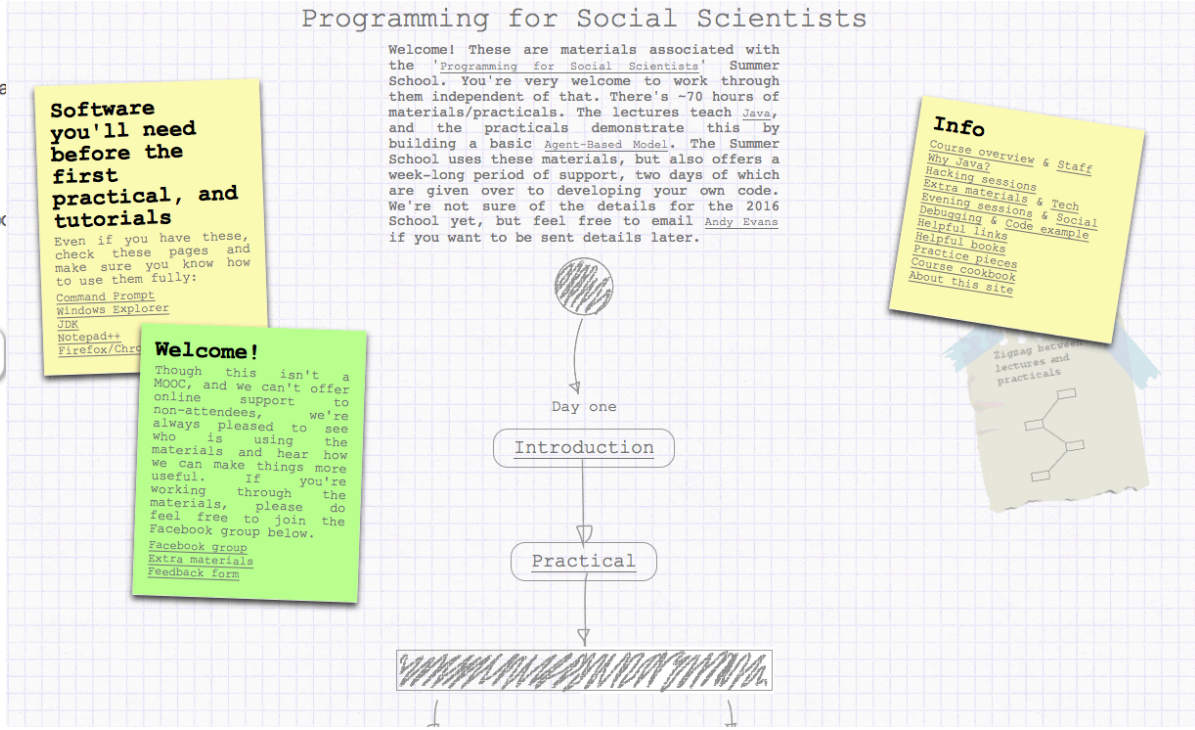
The reading list for the course, which will be updated as the course progresses, is ava

Twitter

GEOG3150 has a Twitter account. You can tweet to the account to ask questions abo information about the course.

You can also follow the lecturers' personal twitter accounts

Follow @GEOG3150 | Follow @nickmalleson | Follow @ajheppenstall



Repositioning of Geocomputation?

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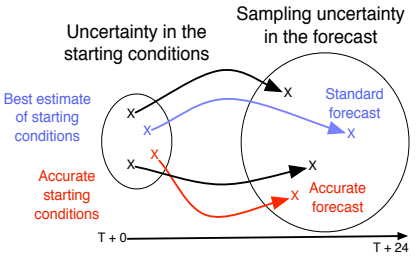
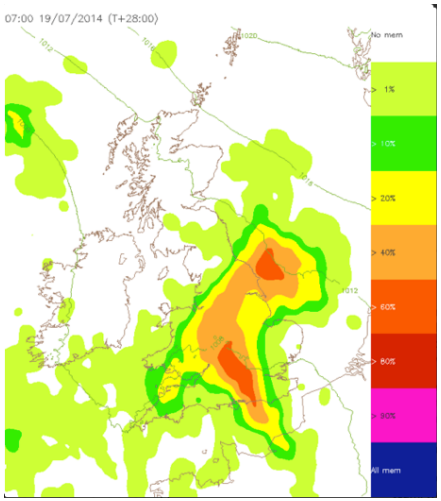
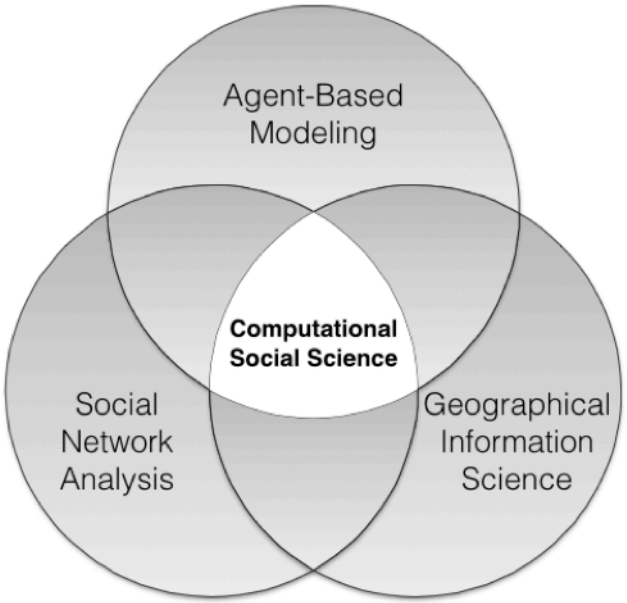
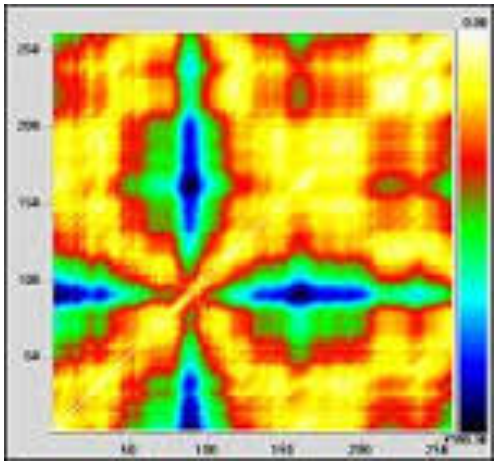






www.gisagents.org: Andrew Crooks



GitHub

Urban Data Science Toolkit

A collection of projects for urban spatial analysis and simulation

San Francisco, CA http://www.udst.org/ udst@autodesk.com

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“I find your lack of faith disturbing”

Thank you!