GIS Research UK
23rd Annual Conference

University of Leeds
15th – 17th April 2015

UNIVERSITY OF LEEDS

Welcome to the 23rd GIS Research UK (GISRUK) conference, hosted by the School of Geography in the University of Leeds. Leeds last hosted GISRUK in 1997 and the conference has continued to grow ever since. This year will see more than 100 papers presented to more than 200 delegates on topics as diverse as health geography, retail science, and fish migration!

Welcoming you to Leeds is particularly exciting for the organising committee at this time. For those of you who attended GISRUK 1997 in Leeds, or have had other occasions to visit the School of Geography, you may be interested to learn that Geography has re-located to the south side of the campus as recently as 30 March. Due to the popularity and success of our School, the need for expansion of our facilities and office space has been on the agenda for a little while and the move to the newly refurbished Grade II listed Garstang-Manton-Miall complex has now come to fruition. We have increased our floor area by over 50%, gaining state-of-the-art computing and laboratory facilities as part of the package. If you would like to be given a guided tour of our new space then please speak to a member of the organising committee.

GISRUK Local organising committee:
Nick Malleson, Helen Durham, Rachel Oldroyd, Paul Norman, Robin Lovelace and Nick Addis.

We would also like to thank our sponsors;

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Conference timetable, and useful information

Wednesday 15th April		
12pm – 1.30pm	Registration	Parkinson Court
1.30pm – 1.50pm	Welcome	Rupert Beckett Lecture Theatre
1.50pm – 2.50pm	Keynote – Ed Parsons	Rupert Beckett
3pm – 4.20pm	Parallel Sessions (1A, 1B, 1C)	See key below
4.20pm – 4.40pm	Break	Parkinson Court
4.40pm – 6pm	Parallel Sessions (2A, 2B, 2C)	See key below
6pm – 8pm	Drinks Reception	Great Hall
Thursday 16th April		
9am – 10.20am	Parallel Sessions (3A, 3B, 3C)	See key below
10.20am – 10.50am	Break	Parkinson Court
10.50am – 12.10pm	Parallel Sessions (4A, 4B, 4C)	See key below
12.10pm – 1pm	Keynotes – Steven Ramage and Dom Stubbins	Rupert Beckett
1pm – 2pm	Lunch	Parkinson Court
2pm – 3.20pm	Parallel Sessions (5A, 5B, ESRI)	See key below
3.20pm – 4pm	Poster sessions	Rupert Beckett
4pm – 4.30pm	Break	Parkinson Court
4.30pm – 5.50pm	Parallel Sessions (6A, 6B, 6C)	See key below
6pm – 10pm	Conference dinner	
Friday 17th April		
9.30am – 10.50pm	Parallel Sessions (7A, 7B, 7C)	See key below
10.50pm – 11.10am	Break	Parkinson Court
11.10am – 12.30pm	Parallel Sessions (8A, 8B, 8C)	See key below
12.30pm – 1.20pm	Keynote – Sarah Williams	Rupert Beckett
1.20pm – 1.40pm	Prizes	Rupert Beckett
1.40pm	Conference closes	

Location key for parallel sessions
A Rupert Beckett Lecture Theatre
B LG19
C LG15

Registration Desk
The registration desk will be manned from 12pm – 6pm on Wednesday 15th April, 9am – 6pm on Thursday 16th April and 9.30am – 2pm on Friday 17th April. If at any point during the conference you have a question, you can speak to someone there or ask anyone with a green lanyard.

Room locations
Sessions and activities over the next three days will take place in the Parkinson Building and Michael Sadler building, where you will find the Rupert Beckett Lecture theatre and lecture rooms LG19 and LG15. There is a map on the back cover of this handbook, as well as signposts around campus.

Posters
Posters will be displayed in the Parkinson Court for the duration of the conference. A special poster session has been arranged for Thursday 16th April, 15:20-16:00. During this session we'd like all authors to stand by their posters and field questions from delegates. There will be a prize for the best poster that all delegates can vote on. The prize will be awarded at the end of the conference.

Conference Reception
Join us for drinks and a buffet dinner from 6pm – 8pm on Wednesday, in The Great Hall at the University of Leeds.

Conference Dinner
The conference dinner will be taking place on Thursday evening, at the Royal Armouries Museum. Those who are attending should meet on the steps outside the Parkinson Building at 6:30pm, if they would like to take a coach to the venue. Alternatively, an informal walk will depart from the Parkinson steps at 5.45pm. Delegates will need to arrange their own travel back from the Armouries, either by walking or with a taxi.

Wifi
Eduroam is available for delegates from subscribing institutions. For those that don't have access to Eduroam, we have separate guest login details. These are available from the Registration desk.

Twitter
The official GISRUK twitter account is @GISRUK. We will be using the #GISRUK2015 hashtag to connect, debate and chat about the conference.

Luggage
On Friday, we have booked the room LG10 (near the lecture theatres) to store luggage before departure.

Keynote speakers at GISRUK2015

Ed Parsons is the Geospatial Technologist of Google, with responsibility for evangelising Google's mission to organise the world's information using geography. In this role he maintains links with Universities, Research and Standards Organisations that are involved in the development of Geospatial Technology. He is currently co-chair of the W3C/OGC Spatial Data on the Web Working Group. Ed was the first Chief Technology Officer in the 200-year-old history of Ordnance Survey, and was instrumental in moving the focus of the organisation from mapping to Geographical Information. Ed earned a Masters degree in Applied Remote Sensing from Cranfield Institute of Technology and holds an Honorary Doctorate in Science from Kingston University, London. Whilst at Kingston, Ed pioneered techniques to make online resources available via the Mosaic Web browser in the early 1990s and also built his own local area network within the university for the distribution of GIS resources.

Steven Ramage has had a very diverse career that began with container ships and marine surveying, before joining Navteq (Nokia HERE) in the 90s. In 2001 Steven joined 1Spatial (previously Laser-Scan) and led the market development of spatial database tools before being appointed as an Executive Director to the Open Geospatial Consortium and later by the Ordnance Survey to lead their international activities. Most recently, Steven became a director of what3words - an organisation that is building a global platform to simply and precisely communicate location using only words. Steven retains contact with the Ordnance Survey as an industry consultant, and also consults for the World Bank. He is a Visiting Professor at the Institute for Future Cities at the University of Strathclyde and a fellow of the Royal Institution of Chartered Surveyors (RICS), and of the Royal Geographical Society (RGS).

Dominic Stubbins is the Chief Architect at Esri UK. He has extensive experience in the delivery of enterprise geospatial solutions for government, defence, utilities and the private sector. In particular, Dominic has focussed on the design of solutions, system architectures and spatial data infrastructures focussed on interoperability and data dissemination within and between organisations. Recently Dominic has been leading the development of new products centred around the analysis of 'big' data sets. Above all Dominic is passionate about using geographic analysis to help understand and change the world we live in.

Sarah Williams is an Assistant Professor of Urban Planning and the Director of the Civic Data Design Lab at Massachusetts Institute of Technology's (MIT) School of Architecture and Planning School. The Civic Data Design Lab works with data, maps, and mobile technologies to develop interactive design and communication strategies that bring urban policy issues to broader audiences. Trained as a Geographer (Clark University), Landscape Architect (University of Pennsylvania), and Urban Planner (MIT), Williams' work combines geographic analysis and design. Sarah's design work has been widely exhibited including work in the Guggenheim and the Museum of Modern Art (MoMA) in New York City.
Before coming to MIT, she was Co-Director of the Spatial Information Design Lab at Columbia University's, Graduate School of Architecture Planning and Preservation(GSAPP). Williams has won numerous awards including being named top 25 planners in the technology and 2012 Game Changer by Metropolis Magazine. Her work is currently on view in the Museum of Modern Art (MoMA), New York.

Abstracts

We have chosen to make the full abstracts from the conference available online. You can access individual abstracts here: leeds.gisruk.org/programme.html or download all abstracts at once from the website.

Session Overview

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Dawn Williams, James Haworth and Tao Cheng

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William Mackaness, Phil Bartie and Philipp Petrenz

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54 *Understanding the urban experience of people with visual impairments*
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112 *New estimates of ethnic mortality - resolving the debate*
Pia Wohland and Phil Rees

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25 *A geospatial relational database schema for interdependent network analysis and modelling*
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35 *The Complexity of Exclusion*
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45 *Real time coupled network failure modelling and visualisation*
Neil Harris, Craig Robson, Stuart Barr and Phil James

100 *Using GeoTools to explore Advice Leeds client data*
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15 *sDNA: how and why we reinvented Spatial Network Analysis for health, economics and active modes of transport*
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20 *Traffic Prediction and Analysis using a Big Data and Visualisation Approach*
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19 *The Influence of Familiarity on Route Choice: Edinburgh as a Case Study*
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Marcus Saraiva, Joana Barros and Maurcio Polidori

124 *Calculating the Overbuilding Potential of Municipal Buildings in London*
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96 *A Simultaneous Model for Demographics, Economy and Infrastructure*
Chengchao Zuo and Mark Birkin

7B New Methods Chair: Nik Lomax Location: LG19 Page 35

5 *Visualize and interactively design weight matrices*
Angelos Mimis

33 *A self-exciting point process model for predictive policing: implementation and evaluation*
Gabriel Rosser and Tao Cheng

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Monsuru Adepeju, Tao Cheng, John Shawe-Taylor and Kate Bowers

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86 *Characterisation and Classification of Hydrological Catchments in Alberta, Canada Using Growing Self-Organising Maps*
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52 *Football fan locality- An analysis of football fans tweet locations*
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89 *Can the sentiment expressed in trail users' tweets help to assess the effectiveness of Environmental Stewardship Agreements? An exploratory analysis of the Pennine Way National Trail, England.*Tom Wilson and Robin Lovelace

115 *Using Mobile Phone Traces to Understand Activity and Mobility in Dakar, Senegal*
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12 *The Utility of Spatial Video for Assessing Risk in Challenging Environments: A Case Study of Cholera in Haiti*
Andrew Curtis, Jason Blackburn, Sarah Smiley, Afsar Ali and John Glenn Morris

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Jacqueline Curtis and Kim Gilhuly

59 *Telling the Story of Globalisation through an Integration and Analysis of Big Data sets*
Anthonia Ijeoma Onyeahialam and Michael Woods

67 *Exploring the usefulness of transport Spatial Tweets from big events: A case study of 2014 Commonwealth Games*
Godwin Yeboah, Caitlin Cottrill, Paul Edward Gault, John Nelson, Jillian Anable and David Corsar

80 *High-Street Resilience and Social Media Opinion Mining*
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88 *Exploring the sentiment of trail users' tweets.*
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94 *Parallel computation for accessibility based planning support*
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Nawaf Alotaibi, Nick Malleson, Andy Evans and Alison Heppenstall

1A Crime and Policing (I)

40 ***Data-driven modelling of police route choice***

Kira Kowalska, John Shawe-Taylor and Paul Longley

In recent years, increasing digitisation of police patrol activities has enabled new insights into police patrol behaviour. This paper explores digitised traces of police patrol journeys in order to understand police routing preferences and to propose models that enable simulations of patrol behaviour. The models assume that police journeys are undertaken as series of topics, which are inferred from vehicle GPS data using a widely used topic modelling technique called latent Dirichlet allocation. Initial experiments have shown that they are capable of reproducing police coverage patterns that would not be captured by alternative models assuming optimal behaviour.

60 ***Exploratory spatiotemporal data analysis of public confidence in the police in London***

Dawn Williams, James Haworth and Tao Cheng

Improving public confidence in the police is one of the most important issues for the London Metropolitan Police Service (Met). Public confidence in the police is a complex relationship with many constituent factors. Furthermore, public confidence varies over geographic space and changes over time. Spatiotemporal analysis becomes more manageable with a thorough understanding of the underlying spatiotemporal autocorrelation structure of the phenomena under scrutiny. Examining the underlying spatiotemporal autocorrelation structure of public confidence is an important first step toward modelling this phenomena. Exploratory spatiotemporal analysis confirmed the presence of nonstationarity in public perceptions of the Met police.

99 ***Analysis of Spatial Patterns of Urban Street Crimes by using GIS: A Case Study of Faisalabad City***

Shoaib Khalid, Jiechen Wang, Mhammad Shakeel and Nan Xia

The present paper discusses the spatial pattern of urban street crimes and the shifting of hotspots in Faisalabad city of Pakistan. The crime reports of 2012 were geocoded and the crime maps were prepared in ArcGIS 10. The strategic crime analysis was done in a series of meetings with police department and crime controlling strategies were built. The Compstat model with some modifications was followed for the accountability and performance management of police department. Operational analysis were carried out for resource allocations and deployment. After implementing crime control strategies it has been observed that there was a remarkable reduction in the street crimes. The crime data of 2013 was plotted on map and the hotspot changing patterns were observed.

107 ***Agent-Based Modelling of Crime***

Nick Addis

Research for crime prediction often focuses on aggregate levels of crime, and consequently any subsequent crime prevention policies implemented are based upon aggregated crime patterns. However, aggregate crime work often fails to connect to the individual-level of the offender, and it is difficult to link broader crime patterns to offending at an individual-level. The current project seeks to address these problems through developing an Agent-Based simulation model of residential burglary, based upon semi-structured interviews with offenders from Leeds and burglary offence data provided by West Yorkshire Police. Using this data, heterogeneous offender groups will be identified based on their behavioural preferences and target selection criteria, using a quantitative Latent Class (cluster-based) Analysis. These groups will provide distinct

information on offending patterns and journeys to crime, to reflect the heterogeneity of offenders within Leeds. The simulation model developed will explore the impact of different crime reduction initiatives and Policing styles with different offender groups, whilst assessing the extent to which offending by different offender groups may be predicted, therefore enabling validation of the model.

1B GIS and the Environment (I)

16 ***Mapping Interactive Behaviour in Wildlife from GPS Tracking Data***
Jed Long
Wildlife researchers now routinely collect detailed data on animal movement using GPS tracking. Methods for studying interactive (e.g., social) behavior in tracked animals remain limited. I propose three new methods for mapping interactive behavior from GPS tracking data,drawing on fundamental geographical concepts, most notably Hagerstrand's time geography. I demonstrate each method on simulated data and will use examples from my research on white-tailed deer tracked with GPS collars to further exemplify each method. My analysis suggests that how interaction is represented in a GIS leads to different interpretations of wildlife behavior, but also unique opportunities for further spatial analysis. Open-source software (in R) is provided for other researchers wishing to implement the proposed methods.

64 ***Participatory mapping for transformation: multiple visual representation of foodscapes and environment in informal settlements in Nairobi***
Sohel Ahmed, Muki Haklay, Adriana Allen, Cecilia Tacoli and Dvila Julio
Although branded as obstructionists and major agents of disease and filth by city authorities, food vendors remain the pivotal node in the local food system in most informal settlements; therefore, their interaction with the environment and infrastructure services, and challenges they face to keep the food safe to eat, requires further grounded exploration. Food vendors from informal settlements in Nairobi, Kenya, who are acting as mappers and change agents, are building multi-layered views of places through the deliberative process of knowledge coproduction by participatory sensing, which lead to opportunities and challenges to improve those places.

75 ***Evolutionary Computing for Multi-Objective Spatial Optimisation***
Daniel Caparros-Midwood, Stuart Barr and Richard Dawson
During the transition to more resilient and sustainable cities, planners require robust planning tools to ensure sustainability efforts do not conflict and negatively affect one another. In this paper spatial optimisation is used to provide best trade-off spatial plans between conflicting real world sustainability objectives during the spatial planning process. Using Pareto-optimal optimisation a series of spatial development strategies are derived that outperform all other possible development strategies in at least one objective. When applied to a case study for a north east local authority the resulting spatial Pareto-optimal strategies were found to significantly outperform the local authorities proposed development plan.

84 ***The role of the age() function in a GIS for ecological conservation***
Greg Wood, Duncan Whyatt and Carly Stevens
This paper demonstrates the use of temporally dynamic GIS attributes in devising and communicating ecological conservation constraints to construction projects. We embed SQL date functions into table view queries, using an open source database management system, to automatically calculate the ages of ecological observations in real time. In

turn, the age attributes are then used in ecological analysis and monitoring applications, such as prioritising ecological survey efforts and estimating resilience to disturbance events. We conclude that the incorporation of temporally dynamic attributes in ecological datasets can help to reduce unnecessary development constraints, delays and expense.

87 ***Identifying perpetuation in processes driving fish movement***
Matt Duckham, Antony Galton and Alan Both
This extended abstract explores ongoing work that is developing new models and algorithms capable of identifying the environmental drivers of human and animal movement. Specifically, the paper presents an algorithm able to identify the perpetuating conditions for movement: those ranges of environmental variables that are necessary for movement to occur. Our algorithm is tested on fish movement data from a large, long-term ecology study in Australia, combined with environmental data about water temperatures, levels, and salinity. The results demonstrate the types of rules that can generated from real movement patterns using our algorithm.

1C Big Data (I)

4 ***GIS, Big Data and Lessons from John Snow***
Doug Specht
This paper examines the work of Snow within the ultra-modern context of big data and GIS, and questions the results that may be born from GIS and Big Data alone. Arguing that while GIS and spatial research have a great potential for unearthing trends, caution must be taken to ensure we do not generate dangerously misleading information about geographical and sociological connections. The paper concludes that when reflecting on contemporary GIS and Big Data practice, that we should look to the work behind Snow's map, rather than being besotted by his famous geographic visualisation.

90 ***Land-use Simulation at Large-scale using Big Data***
Dan Li
Land use/cover changes at larger scales have crucial impact on large-scale environmental problems. Cellular Automata (CA) has become a main tool to simulate and predict land use changes. But large-scale land-use change simulation with high-resolution data requires a large amount of data, complicated computing processes, and very long execution time. The data storage size can be hundreds of megabytes or even several gigabytes, we could consider these data as a kind of Big Data, therefore these big data also lead to the problems of computational capability. A computing model called GPU-CA model is proposed to use the graphics processing unit (GPU) high-performance technique to execute and accelerate such simulations. The comparison indicates that the GPU-CA model is faster than traditional CA by 30 times. Such improvement is crucial for land-use change simulations at large-scales using big data.

105 ***Geodemographics and Big Data A New Research Agenda***
Mark Birkin
Geodemographics has not kept pace with the latest developments. The paper suggests that a qualitative shift has taken place which demands a fundamental reappraisal of methods and perspectives. A number of possibilities will be evaluated in more detail. 1 Geodemographics as a filter for big data 2 Is there an optimal scale for geodemographics? 3 Can interactions be represented and is this helpful? 4 Is it possible to aggregate geodemographic groups and how can this be done? 5 Does new data

change the case for variant classifications? 6 Are there certain data sources which add more value than others should we be more strategic in our approach to their selection? 7 Are there effective ways to exploit the availability of rolling data i.e. updating? 8 Geodemographics in space and time 9 New forms of geodemographics: from you are where you live to you are what you do.

113 ***A Framework for Big Data in studies of Urban Mobility and Movement***
Eusebio Odiari, Mark Birkin, Susan Grant-Muller and Nick Malleson
Various papers and strategies studying urban mobility and movement patterns are reviewed and, categorised according to the mathematical discipline of the models employed. This has enabled the development of a structured framework for studying urban mobility and movement patterns, while taking advantage of the opportunities that big data presents. The choice of strategy for investigating urban mobility and movement is dependent on the type of data and, the particular problem, questions or situation that needs answers. The various types of Big Data come with volume, velocity, variety and veracity, and corresponding ever widening range of solution strategies, calling for a systematic approach based on an objective framework. The particular opportunity that today's data analyst has is the freedom to introduce a new strategy better describing the situation being modelled, and then exploiting the flexibility in today's simulation tools, not limited or constrained as in the past, by purely mathematical concerns. That ability or skill to revise simulation code to suite a particular modelling scenario is a main strength. For illustration purposes, an Agent Based Model (ABM) is used to simulate a railway infrastructure and its populated environs, and data is measured at various points to simulate types of consumer Big Data typically available within economic sector operators. This data is used to review solution techniques adopted in urban mobility papers, while developing solution concepts for illustration to sector operators, with a view to garnering support for the release of real-life data for future research.

122 ***Creating a spatio-temporal Data Feed API for a large and diverse library of historical statistics for areas within Britain***
Humphrey Southall and Michael Stoner
The GB Historical GIS holds 14m. diverse statistical data values in a uniform structure linked to a geospatial ontology of reporting units and a domain ontology of statistical concepts. This paper describes the addition of a Linked Data API enabling programmatic access to this big data structure and discusses topical and spatial sub-setting.

2A - Transport (I)

24 ***TravelOAC: development of travel geodemographic classifications for England and Wales based on open data***
Nick Bearman and Alex Singleton
This paper develops a custom geodemographic classification for travel in England and Wales. Travelling is an important factor in many life decisions, including home and work life. Variables for transport (distance to nearest airport, rail station, ferry station, tram stop and bus stop, number of cars owned, and mode of travel to work) and demographics (gender, age and social class) for each Output Area in England and Wales are used to create eight clusters of different transport characteristics. The characteristics of the different clusters are discussed, along with future improvements to be implemented in the classification method.

32 ***Development of public transport accessibility in the Czech Republic***
Igor Ivan
The convenient system of public transport services belongs to key factors influencing the final decision of public transport use. This paper analyses the development of the level of public transport services, utilising data from Database of Public Transport Connections developed and maintained by the authors. This database contains regularly updated data about inter-municipality public transport connections since 2007 which are suitable for commuting. The development of public transport accessibility in the Czech Republic is analysed by applying spatial analysis methods. Results indicate more complicated relationships between public transport accessibility and local socioeconomic changes.

36 ***Development and application of a two stage hybrid spatial microsimulation technique to provide inputs to a model of capacity to walk and cycle***
Ian Philips
This paper demonstrates the development and application of a two stage hybrid static spatial microsimulation technique. The first stage makes best use of Simulated Annealing with available micro-data, and the second uses Synthetic Reconstruction to add attributes not available in a single micro-data source. The new technique is applied to Leeds UK to generate a synthetic population which can be used as an input to a model of capacity to commute using only walking and cycling.

92 ***Big Data Analysis of Population Flow between TfL Oyster and Bicycle Hire Networks in London***
Nilufer Sari Aslam, James Cheshire and Tao Cheng
This study seeks to undertake an initial analysis of the likely flow of people between the Tube to bicycle hire network in London. Data for the two networks were collected for a month (April 2012) in order to establish the strength of the relationship between them. The results quantify the extent to which Tube commuters impact the capacity utilization of the bicycle network. We expect this research to have implications in the expansion and maintenance of bicycle hire in London and similar schemes around the world.

101 ***Assessing spatial distribution and variability of destinations in inner-city Sydney from travel diary and smartphone location data***
Richard Ellison, Adrian Ellison and Stephen Greaves
Relatively high densities and low car ownership levels in inner Sydney are associated with much lower levels of car use than other parts of Sydneys Metropolian Area but it is unknown how this affects the distribution nor the variability in destinations. Following processing of a dataset derived from a seven week travel diary and smartphone app, spatial density analysis is conducted on the destinations by variables including mode, purpose and day of the week. The results show substantial differences in choice of destinations depending on what mode is used and the purpose of the trip.

2B - Health

3 ***Mapping of Spatial Distribution of Tuberculosis Cases in Kebbi state Nigeria 2008-2011***
Usman Lawal Gulma
The World Health Organization has declared tuberculosis a global emergency in 1993. It has been estimated that one third of the world population is infected with mycobacterium tuberculosis, the causative agent of tuberculosis. The identification of clusters in spacetime is of great interest in epidemiological studies. The objective of this

paper was to identity and map the spatial distribution of tuberculosis during the period 2008 - 2011 in Kebbi state.Kernel Density Analysis tool in Arcgis Spatial Analyst was employed to map the trend of TB cases over the period. The results revealed that the highest occurrence of 2,220 cases was in 2009 while year 2011 recorded the least cases of 1,179 across the state. It as further revealed that Birnin Kebbi LGA with a population of 268,620 recorded the highest cases of 1,639. However, Suru LGA with population of 148,474 recorded only 70 cases over the period. In conclusion, TB cases were unevenly distributed but high cluster rates were identified in the four emirate headquarters of Born in Kebbi, Argungu, Yuri and Zuru. Increasing the number of diagnostic and treatment centers were recommended in order to reduce the number of cases across the state.

21 ***The changing geography of deprivation in Britain: exploiting small area census data 1971 to 2011***

Paul Norman

This paper will describe the method used to devise a time-series of area deprivation 1971 to 2011 using census data for all years harmonised to contemporary definitions of LSOAs / Datazones in GB. Areas which are persistently deprived or advantaged over time will be highlighted and trajectories of change will be identified to reveal locations on the up or on the slide. Various facets will then be analysed in relation to changing deprivation such as: the ageing population; health inequalities and educational achievement.

28 ***Is the use of 'mobile computer technology' appropriate for locating people with dementia?***

Steve Williams and Mark Ware

This paper discusses ethical and viability issues relating to safer walking technology using a mobile phone. This technology is used to locate people with dementia when they get lost (or wander). In particular, the paper highlights problems of accuracy and availability when using GPS based techniques to locate a person, especially when that person is in a built up area or indoors. Experimental results are presented that suggest Wi-Fi based positioning offers a possible solution in such situations. The paper is presented in the context of a larger project that is considering a wider range of ethical and viability concerns.

70 ***Assessment of social vulnerability under three flood scenarios using an open source vulnerability index***

Kurtis Garbutt, Claire Ellul and Taku Fujiyama

This paper utilises an open source flood vulnerability index to assess changes in social vulnerability within the English county of Norfolk under three flood scenarios. Open source demographics data is combined with flood zone data and GIS analysis of accessibility to key services to create the flood vulnerability index. The impact of flooding was found to be disproportionately distributed amongst those areas recording a high level of social vulnerability before flood risk was included. Analysis suggests those at risk of flooding are more likely to be elderly, poor and have long-term health problems.

2C - Visualisation

30 ***Spatially modelling dependent infrastructure networks***
Craig Robson, Stuart Barr, Philip James and Alistair Ford
The resilience of infrastructure networks to different types of perturbation is of significant interest due to the importance of these systems for the efficient functioning of modern society. Significant failures such as power blackouts and their subsequent knock-on effects on other infrastructures are particularly important to understand. We present a spatially explicit method for representing infrastructure spatial dependencies and modelling of failure impacts using a PotsgreSQL-PostGIS database coupled with spatial network failure models. The utility of the methodology is shown by simulating how the London underground may respond to different failure types on the South East electricity transmission grid.

77 ***Cartography, Location-Based Gaming and the Legibility of Mixed Reality Spaces***
Jonny Huck, Paul Coulton and Adrian Gradinar
This paper presents a number of cartographic design solutions to the creation of a map for the mixed-reality location-based game Pac-Lan: Zombie Apocalypse. The research-purpose of this game is to explore ways in which players may be encouraged to become less reliant upon the device screen during gameplay, and so more fully engaged with the physical environment in which the game is played. In this paper we specifically consider approaches to designing the game-map in such a way as to discourage players from becoming solely reliant upon it for navigation, and instead interact more with their surroundings during gameplay. This paper therefore considers four maps as potential solutions for Pac-Lan: Zombie Apocalypse, which serve explore the use of abstract feature representation as a cartographic device to encourage player engagement with the landscape. A description of the design rationale for each of the maps is presented here, along with some preliminary findings from user evaluation of the maps against a defined set of design goals.

83 ***Spoilt for Choice? An Investigation Into Creating Gastner and Newman-style Cartograms***
Chris Brunsdon and Martin Charlton
A number of choices are encountered when creating cartograms using the Gastner and Newman algorithm. Two important ones are the starting map projection, and the resolution of the grid size used to compute the cartogram transform. We experiment with a number of projection and grid size combinations, and define a measure of cartogram success, and use this, together with a more descriptive assessment, to identify best practice in choosing resolution and initial projection.

85 ***Beyond Visualisation in 3D GIS***
James Milner, Kelvin Wong and Claire Ellul
Although 3D visualisation is becoming more common in GIS, as of yet, there has been relatively little in the way of 3D editing and analysis functionality especially in the web. This research describes a first attempt at addressing this deficit, documenting a 3D Web GIS with the ability to select, edit, 3D buffer, measure and retrieve attributes. A small user evaluation was undertaken to assess aspects such as usability, consistency and responsiveness. The system developed was implemented using Three.js as a frontend 3D framework and PostGIS as a backend database. The GIS was successful in its

execution but detected some issues in requirement of addressing in order to progress. It concludes with recommendations to improve performance and go further with 3D editing.

125 ***Data Exploration with GIS Viewsheds and Social Network Analysis***
Giles Oatley, Tom Crick and Ray Howell
We present a novel exploratory method combining line of sight visibility (viewshed analysis) and techniques from social network analysis to investigate archaeological data. At increasing distances different nodes are connected creating a set of networks, which are subsequently described using centrality measures and clustering coefficients. Networks with significant properties are examined in more detail. We use this method to investigate the placement of hillforts (nodes) in the Gwent region of south-east Wales, UK. We are able to determine distances that support significant transitions in network structure that could have significant archaeological validity.

3A - Crime and Policing (II)

48 ***A Model Officer: An Agent-based Model of Policing***
Sarah Wise and Tao Cheng
The way police officers create guardianship is poorly understood, in part because of the complexities of policing. However, in order to understand how to advise the police, researchers must have an understanding of how the current system works. The work presents an agent-based model that simulates the movement of police vehicles, using a record of calls for service to emulate the demands on the police force. The GPS traces of the simulated officers are compared with real officer movement GPS data in order to assess the quality of the generated movement patterns.

82 ***Quantifying the deterrent effect of police patrol via GPS analysis***
Toby Davies and Kate Bowers
The efficacy of police patrolling as a means of crime deterrence remains a significant area of uncertainty within crime prevention study. It is, however, an issue of substantial practical importance, since the design of policing strategies depends crucially on knowledge of the form and intensity of intervention required to achieve a given effect. Here, we examine GPS traces of police vehicle movement in a major UK city in order to quantify precisely the patrol activity applied to each street segment. This is then compared against crime data to test, and estimate the magnitude of, the deterrent effect of patrolling.

95 ***Understanding Spatio Temporal Patterns of Crime Using Hotspot AND Coldspot Analysis***
Ellie Bates and William Mackaness
This paper argues that we need to think as much about where crime does not happen as where it does. The use of hotspot maps is a widely accepted practice in policing, These maps highlight areas with high concentrations of crime but tell us less about areas with medium or low concentrations of crime. Understanding what makes a low crime place may provide lessons for reducing crime. This paper proposes techniques which use a mixed method approach, combining LISA, Group Trajectory Analysis and Focus Groups, to give us a more nuanced and detailed understanding of crime at the neighbourhood level.

118 ***Understanding the spatial pattern of urban crime: a developing countrys perspective***
Faisal Umar, James Cheshire and Shane Johnson
Much of the published spatial analysis research of crime to date has been focused on Euro-American cities. This paper attempts to provide an insight on how we can better understand the spatial pattern of crime in a typical developing countrys setting. Data were obtained through extensive field mapping, a block environmental inventory (BEI) and a crime victimization survey to generate a GIS-database of the study area. Grid thematic maps (GTM) for different crime types were produced for visual analysis, which suggests, as observed in many Euro-American studies, crime clusters geographically.

132 ***Utilising GIS capabilities to study and analyse the spatial distribution of crimes in Kuwait***
Nawaf Alfadhli, Graham Clarke and Mark Birkin
Preventing crime is a challenging issue for analysts and planners. Most modern societies have begun to effectively utilise Geographical Information Systems (GIS) technology to develop their strategic plans to monitor and locate crime events.However, the implementation of GIS technology within the crime field has been very limited in the local authority of Kuwait. Therefore, this case study seeks to examine how GIS technology can play a very critical role in Kuwait, particularly how decision makers and planners can use the location-allocation and spatial interaction models to monitor, analyse and prevent criminal activity through data in terms of the spatial distribution and its attributes.

3B - Geodemographics (I)

23 ***Can administrative data be used to create a geodemographic classification?***
Mildred Ajebon and Paul Norman
This paper aims to contribute to the wider research scheme of the ONS Beyond 2011 project by assessing the feasibility of creating geodemographic classifications from administrative statistics as a way of eliminating the need for a full population survey. The classification is created using K-Means clustering algorithm which is then compared with OAC super-groups as a benchmark in maps and cross-tabulations. Results show similar classification of area types and health variations in England suggesting that the range of administrative datasets examined in this study could be explored as viable alternatives to the traditional census approach.

27 ***Towards a Seamless World Names Database***
Alistair Leak, Paul Longley and Muhammad Adnan
This paper sets out to address limitations in a global database of personal names (worldnames.publicprofiler.org: WND). A synthesis of 26 publicly available electoral register and telephone directory datasets. However, it has proven difficult to source further data that are representative of some other countries resident populations. Thus, this study seeks to evaluate the potential for proxy registers based on geotagged Twitter data and further, to devise a method for evaluating the datas' quality. The paper concludes with a discussion of the problems arising where there are no registers or directories against which population registers or directories might be compared.

102 ***Creating an Output Area Classification of Cultural and Ethnic Heritage to Assist the Planning of Ethnic Origin Foods in Supermarkets in England and Wales***
Guy Lansley, Yiran Wei and Tim Rains
This paper presents a Cultural, Ethnic and Linguistic Output Area Classification for England and Wales built from clustering census variables which pertain to cultural identity. The study provides a quick insight into the broad patterns in ethnic segregation based on the residential geography recorded from the 2011 Census and is therefore a useful tool for supermarket planners seeking to identify areas where to target particular ethnic origin foods. To confirm this association, the classification has also been compared with the total sales of a selection of ethnic origin foods using supermarket customer loyalty data.

114 ***Census statistics for Civil Parishes When best-fitting just isnt good enough***
Bruce Mitchell
Summary The Government Statistical Service (GSS) National Statistics Geography Policy published by the Office for National Statistics (ONS) defines the way that statistics for any geography larger than Census Output Area should be generated. For Civil Parishes in England this best fit method is not satisfactory. ONS is therefore examining the relative merits of other methods of aggregating Census data to parishes, especially with reference to grid cells. The outcome of the research will inform a decision on which method to mandate for the 2021 Census.

127 ***Alternative Approaches to Forecasting Migration: Framework and UK Illustrations***
Philip Rees, Nikolas Lomax and Peter Boden
This paper is a review of the migration component of population projection models. A general population accounting framework is defined that underpins projection models. The framework identifies migration variables internal to a country, international migration to and from a country and its constituent regions and international migration between other countries. These different types of migration can be represented in projection models as flows (migration numbers), flows projected by a time series model, migration transmission rates multiplied by the origin population at risk, migration admission rates multiplied by the destination population at a risk, or through an explanatory model. The arguments for and against each migration projection model are discussed through an analysis of 16 projection examples linked to published studies. The importance of understanding the forces affecting migration at origin and destination is stressed. Simulation experiments are carried out for a UK population disaggregated by the ethnicity, testing model results against 2001-2011 estimates. The paper shows how a proper understanding of the spatial context is needed for successful population projections.

3C - Big Data (II)

39 ***The Impact of Task Workflow Design on VGI Citizen Science Platforms***
James Sprinks, Jeremy Morley, Robert Houghton and Steven Bamford
Citizen science platforms allow non-scientists to take part in scientific research across a range of disciplines, and often involve the collection of volunteered geographic information from remotely sensed imagery. What these systems ask of volunteers varies considerably in terms of task type, level of user judgement required and user

freedom. This work studied the Zooniverses Planet Four project and investigated the effect of task workflow design on user engagement and outputs. Results show participants found the more guided, less-autonomous interface more frustrating, while the less complex, repetitive interface resulted in greater data coverage.

65 ***Is VGI Big Data?***

Peter Mooney and Adam Winstanley

Volunteered Geographic Information (VGI) has become a popular source of geographic data for GIS practitioners in recent years. VGI datasets are characterised as being: large in volume, subject to dynamic changes and updates, collected through crowdsourcing architectures using a variety of devices and technologies and contain a mixture of structured and unstructured information. Can we call VGI a form of Big Data? Are VGI datasets developing characteristics that make processing them using traditional data processing applications and techniques difficult and unsatisfactory? We explore this question with reference to a number of sources of VGI.

66 ***Understanding car ownership elasticities in England and Wales: Advancing the evidence base with new data sources***

Godwin Yeboah, Jillian Anable, Tim Chatterton, Jo Barnes, Eddie Wilson, Oliver Turnbull and Sally Cairns

This study presents global and local models explaining household car ownership elasticity in England and Wales based on new datasets from Experian household median income and 2011 Census released by UK Government agencies. Latest empirical evidence on car ownership elasticity across the area is based on 2001 Ward level household average income estimates and 2001 Census. In using different income estimates and new datasets, new evidence is compared with what we already know about car ownership elasticity. Geographically weighted regression is utilized to estimate and forecast car ownership elasticities at both Ward and Lower layer Super Output Areas. With our initial modelling in this paper, we suggest that future work should incorporate road worthiness tests data, at lower geographies when released, from Ministry of Transport (MOT) as a proxy for car ownership to undertake a comparative analysis towards deepening our understanding of car ownership trends to inform transport policy in England and Wales.

76 ***Optimising sentiment analysis in commercial context***

Radoslaw Kowalski

The proposed paper is about data analysis of consumer reviews of Argos products. The objective behind the paper is to use the review data to produce insight for Argos managers so that they can reduce the rate of returns for products they sell to customers. Methodological innovation for the purpose of this research assignment is to improve on the sentiment analysis model used currently, including an attempt to detect and interpret irony. Furthermore, this study aims at a systematic identification of best solutions for making data summaries as insightful and as easy to interpret as practicable.

119 ***Assessing the quality of OpenStreetMap building data and searching for a proxy variable to estimate OSM building data completeness***

Claire Fram, Katerina Chistopoulou and Claire Ellul

The OpenSteetMap (OSM) buildings database reflects dense constellations of dwellings, offices, municipal buildings, and myriad other buildings. However, the quality of OSM

building data is largely unknown. This study investigates the quality of OSM building data using case studies of cities in the United Kingdom. This study addresses three objectives: first, how complete is OSM building data in urban areas of the UK; second, what are the biases present in methodologies used for quantifying the quality of polygon vector data; and lastly can proxy variables be used to indicate OSM building data completeness in urban areas.

4A - Urban

22 ***Group Behaviour Analysis of London Foot Patrol Police***
Jianan Shen and Tao Cheng
The main objective of this research is to propose a method for group movement pattern generalisation and classification. To this end, DBSCAN is used on stay points for POI identification. Then, movement features are extracted and selected for the behaviour classification. A kernel-based Support Vector Machine method is developed to infer the working types of the officers based on the selected features depicting their movement histories. By analysing the geo-tagged police data, we demonstrate how this method can be used to reveal user information, especially interest information based on their POIs and spatial-temporal movement patterns.

53 ***Are we there yet? Exploring distance perception in urban environments with mobile Electroencephalography***
Katerina Skroumpelou, Panagiotis Mavros and Andrew Hudson Smith
This paper explores the use of mobile Electroencephalography (EEG) in the study of environmental perception and the ways the perception of physical measurements of a space may affect individual walking behaviour. The hypothesis of this study is that obtrusive and complex street environments stretch the perception of walking time and distance. So far, the factor of an individuals affective state has not been taken into account in perceiving space. We propose the use of mobile EEG, a technology that permits such insights, to augment the traditional arsenal of questionnaires and self-reported measures of experience and mental representations of space.

55 ***Strategies in the Use of Referring Expressions to Describe Things Urban***
William Mackaness, Phil Bartie and Philipp Petrenz
In the context of wayfinding technologies, there is increasing interest in dialogue based systems that use description of landmarks as a way of guiding people through cities. In the absence of maps and photographs, the challenge for automated systems is the production of descriptions of things in the field of view that are unambiguous and easily interpreted. We are therefore interested in the mechanisms used by humans to create and interpret descriptions of things in the urban vista. Here we report on a web based experiment in which we explored the veracity of human generated referring expressions in order to better understand the most successful strategies for directing peoples gaze.

79 ***Mapping to Disrupt unjust urban trajectories***
Rita Lambert and Adriana Allen
This paper shares the experience of the research project 'Mapping Beyond the Palimpsest' which adopts grounded applications and cutting edge technologies for community-led mapping and visualization, to reframe the understanding of, and action upon, two highly contested territories in Lima; the Historic Centre - Barrios Altos, and Jose Carlos Mariategui, in the periphery. Adopting a participatory action-learning approach, the research seeks to disrupt the exclusionary trajectory of urban change,

develop the writing of more inclusive representations and open up spaces for collectively negotiated outcomes between marginalised citizens, planners and policy makers.

103 ***Designing 3D Geographic Information for Navigation Using Google Glass***
Kelvin Wong and Claire Ellul
No longer bound by traditional 2D physical representations, there is a steady shift towards three-dimensional (3D) data. Existing research recognises landmarks to be important navigational but specific geometric and semantic attributes in 3D have not been identified. This study offers a user-centred investigation into assessing of the saliency of environmental objects which facilitate pedestrian navigation. A novel real-world navigation experiment using Google Glass is carried out with fourteen participants. Results show geometric and semantic detail for navigation are most pertinent between 1.65 7.5m for buildings. Visual characteristics such as colour, shape and texture are more relevant than function and use.

4B - Health

11 ***Combining Statistics and Texts Using GIS: Nineteenth Century Health Reports***
Catherine Porter, Paul Atkinson and Ian Gregory
This paper combines Geographic Information Systems (GIS) and Natural Language Processing (NLP) to explore how statistics and textual information may be compared. Combined with known mortality figures, for the first time, this research provides a spatial picture of the relationship between the Registrar-Generals discussion of disease and deaths in England and Wales during the nineteenth and early twentieth centuries. A variety of techniques are employed to provide a new view on whether government published texts were directly related to changing mortality patterns during this time.

47 ***Objectively scrutinising the impact of the obesogenic environment on obesity in Yorkshire, England: a multi-level cross-sectional study***
Matthew Hobbs, Jim McKenna, Mark Green, Hannah Jordan and Claire Griffiths
Modification of the obesogenic environment currently represents a key focus of local authority health policy. It is interesting that despite lobbying from policy, contemporary evidence on the obesogenic environment is essentially in its infancy. The BEYH (Built Environment Yorkshire Health) study; a large (n=27,806) multi-level and cross-sectional study aims to assess the impact of exposure to the food and physical activity (obesogenic) environment on an individuals body weight. Measures of the built physical activity and nutritional environment will be objectively measured using Geographic Information Systems (GIS). Multi-level models will explore how both individual- and neighbourhood-level factors contribute to body weight.

54 ***Understanding the urban experience of people with visual impairments***
Panos Mavros, Katerina Skroumpelou and Andrew Hudson Smith
One of the major issues visually impaired people face in everyday is the difficulty to navigate the city independently, which has implications for their wellbeing and health. As part of a research collaboration with the Guide Dogs for the Blind Association and Future Cities Catapult, we have employed mobile Electroencephalography (mEEG) to study the urban experience of visually impaired people. Our pilot study demonstrates the potential of such methods to provide insights both through the analysis of data, but also by using the visualisation of emotional experience of the city as a tool for empathy.

58 ***Comparing the Quality of Local Authority Spatial Data***

Amy Mizen, Sarah Rodgers and Richard Fry

This investigation will evaluate the quality of data, including addresses, provided by local authorities. In order that we may collect a time series of data to be used in a natural experiment. The outlet data will be used to model the food environment of child home-to-schools at household level. This environmental data will then be linked to routine health data, which will allow the analysis of the relationships between child health and environmental exposures. When using local authority data, absolute accuracy should not be assumed. However, local authority data can provide researchers with valuable information that may not be captured in national datasets. The value of local council data should be promoted so to encourage more stringent data capture and recording methods.

112 ***New estimates of ethnic mortality - resolving the debate***

Pia Wohland and Phil Rees

The ethnic composition of the UK is changing; about 20% of the population defined themselves as not White British by 2011. Still, information on mortality for ethnic groups, an important population health indicator, is not routinely collected everywhere the country.Previously, we developed the first estimates of ethnic mortality for local areas in the UK for 2001 using information on the geographical distribution of the ethnic populations as well as health and vital statistics information and found profound variations across groups. With updated information available from the recent census, we now produced ethnic mortality estimates for 2011. This paper will discuss how our results can be set in context with other emerging literature and how ethnic mortality has changed over the decade.

4C - Technical Challenges

25 ***A geospatial relational database schema for interdependent network analysis and modelling***

David Alderson, Stuart Barr, Tomas Holderness, Craig Robson and Alistair Ford

Services delivered via National Infrastructure (NI) are key to securing economic growth and societal well-being. Spatially complex interdependent networks form an integral component of NI (e.g. energy supply, transport, waste management, clean water supply and dirty water treatment). It is essential that such infrastructure networks and interdependencies can be managed, analysed and modelled in a robust and consistent manner. This paper presents work undertaken to develop a spatial interdependent network model within existing relational database management software that is suitable for national-scale representation of infrastructure network systems and their interdependencies.

35 ***The Complexity of Exclusion***

Jacobus Van Rooyen and Joana Barros

Two decades have passed since South Africa celebrated its first democratic election and witnessed the emergence of a new country. However, legacy of spatial segregation and economical exclusion presisted. Formulating an understanding of this phenomenon provides the basis of this research project. Using agent-based modelling the study aims to analyse the complex composition of two societies and to demonstrate the potential for integrated future development.

43 ***Semantic and geometric enrichment of 3D geo-spatial building models with photo captions and illustration labels***

Jon Slade, Christoper Jones and Paul Rosin

Whilst the number of 3D geo-spatial digital models of buildings with cultural heritage interest is burgeoning most lack semantic annotation that could be used to inform users of mobile and desktop applications about the architectural features and origins of the buildings. As part of an ongoing project this research describes methods for enriching 3D models with generic annotation implied from images of building components and from labelled building plans and diagrams, and with the text from object-specific photo captions from social media. The work is part of a broader initiative aimed at annotating 3D models with elements of text from authoritative architectural guides.

45 ***Real time coupled network failure modelling and visualisation***

Neil Harris, Craig Robson, Stuart Barr and Phil James

This paper, presents an approach to real-time spatio-temporal analysis of infrastructure network performance by developing an open source geovisualisation tool coupled with infrastructure network failure models in order to simulate, visualise and analyse how spatial infrastructure networks respond over time to major perturbations and failures.

100 ***Using GeoTools to explore Advice Leeds client data***

Andy Turner and Stuart Hodkinson

As part of the Digital Welfare project [1] a Java GIS library called GeoTools [2] has been used to automate the production of numerous maps. The extended abstract outlines this work and provides some detail of the geographical analysis involved. The main source data are: client enquiry data obtained from the main advice giving agencies in Leeds Local Authority District (LAD); and, housing and council tax benefit claimant data for Leeds LAD. The primary data are spatially referenced by residential postcodes either at the postcode unit or postal sector level. The data have been explored and are being analysed for specific purposes that are outlined.[1] http://www.geog.leeds.ac.uk/people/a.turner/projects/DigitalWelfare/[2] http://www.geotools.org/

5A - Big Data (III)

13 ***Evaluating the Spraycan: understanding participant interaction with a PPGIS***

Jonathan Huck, Duncan Whyatt and Paul Coulton

Whilst widely accepted as an important facet of software design, the evaluation of PPGIS usability is often overlooked in research. This work comprises a novel approach to the evaluation of the Spraycan PPGIS, whereby rich insights into participant behaviour are drawn from data that are natively collected by the platform as opposed to through additional questionnaires, log files or similar. The approach will be validated against a traditional questionnaire, before conclusions are drawn relating to the usability of the Spraycan as a platform for the collection of vague spatial data, in the hope of developing a greater understanding into the way in which people interact with geographic problems.

15 ***sDNA: how and why we reinvented Spatial Network Analysis for health, economics and active modes of transport***

Crispin Cooper and Alain Chiaradia

We introduce sDNA, a GIS/CAD tool and methodology for analysis of spatial networks. The design decisions behind the tool are documented, in particular the choice of standardizing on the network link in order to match existing data standards and increase

computational efficiency. We explore the effects of this decision on algorithm design, and present results that validate our decision to depart from a recent tradition and revive a much older one.

20 ***Traffic Prediction and Analysis using a Big Data and Visualisation Approach***
Declan McHugh
This abstract illustrates an the result in an approach of using big data, visualization anddata mining techniques used to predict and analyse traffic. The objective is to understandTraffic patterns in Dublin City. The data captured was from open data portals. The predictionmodel was developed using multivariate regression and statistical models and Weather featuresusing Linear and non-linear algorithms visually correlated with real-time traffic tweets. Usingthe prediction model and tweet event detection the result was high-performance webapplication containing over 500,000,000,000 traffic observations that produce analyticdashboard providing traffic prediction and analysis.

44 ***Geospatial Big Data for Finding Useful Insights from Machine Data***
Pouria Amirian, Francois Van Loggerenberg, Trudie Lang and Margaret Varga
The focus of this paper is on finding useful insights from data generated by Point-Of-Care (POC) Diagnostics devices based on spatio-temporal data analytics. At first glance data generated by the molecular POC diagnostic devices seems not very relevant to geospatial Big Data. However by including location of the devices (which are usually locations of the healthcare settings e.g. hospitals or labs) in the analysis and by inclusion of other geographic layers, whole new set of useful questions can be asked and therefore many useful insights can be found using big data technologies.

5B - Historical GIS

2 ***Ephemeral Londoners: Modelling Lower Class Migration to Eighteenth Century London***
Adam Dennett, Adam Crymble, Tim Hitchcock and Louise Falcini
Between 1750 and 1801 the population of London grew from approximately 750,000 to 1.1 million people. Relocating to London in the eighteenth century only occasionally generated a paper trail, but a significant number of failed migrants were rounded up for wandering and begging on the streets and sent back from whence they came to their parish of legal settlement. Records of these removals have been digitised and are used in this paper to model migration into London, to throw light onto the patterns of movement at this time.

14 ***Do Geospatial & Heritage standards work and do they work together?***
Glen Hart
This research compared the ability of three geospatial and heritage standards to meet the needs of a heritage organisation concluding that the standards in either isolation or combination did not fully meet the requirements and that the nature of the standards made it difficult for them to work together. The work recommends the development of micro-standards to overcome these difficulties.

31 ***HAG-GIS: A spatial framework for geocoding historical addresses***
Konstantinos Daras, Zhiqiang Feng and Chris Dibben
The Digitising Scotland (DS) project aims to digitise the 24 million vital events record images (births, marriages and deaths) for all residents in Scotland since 1855 (ie transcribe them into machine encoded text). This will allow research access to

information on individuals and their families for those who have ever lived in Scotland between 1855 to the present day. In this paper we present the methodology for geocoding these 24 million historical addresses in Scotland from 1855 to 1974 by introducing the Historical Address Geocoder GIS (HAG-GIS) spatial framework and its matching algorithms implemented for the needs of the DS project. The matching processes link the historical addresses to the contemporary addresses by exact and fuzzy matching algorithms. Apart from geocoding the historical addresses, we also produce pseudo registration district boundaries using the pilot historical addresses from death event records in 1950 and 1951.

46 ***Reconstructing the Agricultural Landscape of the South Downs, England: an Examination of the 1940 and 1941 World War II Plough-up Campaigns***
Nigel Walford
World War II and the following decades are often regarded as a pivotal point in the changing fortunes of British agriculture during the 20th Century. Preparations for the wartime emergency included a National Farm Survey that would reveal land capable of more intensive production. This paper outlines the development of an historical GIS of different data sources and focuses on the ensuing plough-up campaigns of 1940 and 1941 on the South Downs, England and their legacy during the post-war decades as well as factors contributing to continuity of occupation by farm families.

109 ***Researching long-run trends in South East England 1841-2011 for the European Union and Greater London Authority***
Paula Aucott and Humphrey Southall
This paper describes the sources, methods and preliminary results of two related projects on historical census data funded by government bodies for policy purposes. Both required data for diverse historical reporting areas to be redistricted to a single set of modern units. All redistricting is done by a simple vector overlap method, but this requires boundary data for both the modern and the historical units; and, as far as possible, that the historical units be more detailed than the modern ones. Even for recent periods, locating boundary maps is often much harder than locating statistics.

6A - Transport (II)

26 ***Spatio-Temporal Patterns of Passengers Interests at London Tube Stations***
Juntao Lai, Tao Cheng and Guy Lansley
With as many as 3.5 million passengers using the London underground system every day, it is desirable to examine and understand their interests and opinions, and to harness this information to improve the services of Transport for London (TfL). This research aims to achieve a better understanding of passengers interests by harvesting text from geo-tagged Tweets sourced over a four week period in 2014 from the vicinity of the stations. An unsupervised topic modelling method Latent Dirichlet Allocation (LDA) is used to generate topics, and k-means is used to cluster stations in order to understand the overall patterns of topics.

49 ***Assessing the need for infrastructure adaptation by simulating impacts of extreme weather events on urban transport infrastructure***
Alistair Ford, Maria Pregnolato, Richard Dawson, Stuart Barr and Katie Jenkins
Cities face risks from climate change, placing increased pressure on infrastructure extremes. A methodology to assess the impacts of extreme weather events on urban networks has been developed, using a catastrophe modelling approach to risk

assessment by overlaying spatial data, applying hazard thresholds, and testing potential adaptations. Utilising future climate projections, downscaled using stochastic weather generators, future urban temperature and flooding extremes are simulated. These are coupled with spatial urban transport network models and, applying thresholds, disruption to the networks can be simulated. Results for heat and surface water flooding events, and the impacts on the travelling public, are demonstrated.

71 ***Crowd sourced vs centralised data for transport planning: a case study of bicycle path data in the UK***

Robin Lovelace

This paper seeks to test the often mooted hypothesis that distributed, user-contributed 'crowd sourced' GIS data will eventually supercede the traditional centralised geographic data model. The empirical basis used to explore this question is a couple of national-level datasets on a specific topic: bicycle paths in the UK. Open Street Map data represents the crowd-sourced model; Ordnance Survey's Urban Paths layer represents the centralised model. To assess the quality of each dataset, an array of tests was used, from narrow tests of accuracy against aerial photography, to more subjective tests of usability and practical utility. Overall it was found that the OSM data model won on the majority of criteria. However, it must be noted that this is a niche area. If the crowd-sourced data model is to triumph in more mainstream areas it needs to ensure much greater community 'buy-in', for example through compulsory engagement with Open Street Map for educational and citizenship purposes at school.

98 ***Spatiotemporal Identification of Trip Stops from Smartphone Data***

Adrian Ellison, Richard Ellison, Asif Ahmed and Stephen Greaves

As part of a three-year study on cycling infrastructure, a smartphone app was used to passively collect location information resulting in 54 million observations. These data are then used to identify trip stops using a new method that employs a moving average position. In total 12,849 stops are identified with a median time of one hour and a spatial distribution consistent with the travel diary data collected as part of the same study.

6B - GIS and Hazards

17 ***Assessing the impact of seasonal population fluctuation on regional flood risk management***

Alan Smith, Andy Newing, Niall Quinn, David Martin and Samantha Cockings

This paper focuses on the integration of population and environmental models to address the effect of seasonally varying populations on exposure to flood risk. A spatiotemporal population modelling tool, Population24/7, has been combined with LISFLOOD-FP inundation model outputs for a study area centred on St Austell, Cornwall, UK. Results indicate seasonal cycles in populations and their exposure to flood hazard which are not accounted for in traditional population datasets or flood hazard analyses and which provide potential enhancements to current practice.

18 ***Assessing the risk landslides pose to road and rail networks***

Khaled Taalab and Tao Cheng

Road and rail networks are critical infrastructure, vital for ensuring the flow of essential goods and services necessary to maintain a countrys economic and national security. Landslides are a natural hazards which can seriously affect these networks, so in order to plan mitigation strategies, calculate losses and minimise casualties, it is necessary know the risk a posed by landslides. Using a case study of Piedmont, Italy, this study

proposes an empirical modelling approach to the quantification of landslide risk using support vector machines and simple network analysis.

42 ***Exploring new ways of digital engagement: a study on how mobile mapping and applications can contribute to disaster preparedness***
Enrica Verrucci, Gretchen Fagg and Patrick Rickles
Natural disasters can happen at any time and no community can consider itself completely safe from them. Digital technologies, such as Geographic Information Systems (GIS), are becoming globally pervasive (World Bank, 2014), with smartphones hosting excellent mobile mapping, data collection and information providing platforms. A report was compiled to investigate web and mobile applications that provide preparedness information and stimulate community empowerment, some using maps as a medium to convey the information. This body of work discusses the purpose, results and implications of this analysis for further work to be undertaken to address the identified research gap.

81 ***SAFEVolcano: Spatial Information Framework for Volcanic Eruption Evacuation Site Selection-allocation***
Jumadi Jumadi, Steve Carver and Duncan Quincey
Volcanic disasters are commonly difficult to predict accurately in term of when the events come, how big the magnitude, where the spatial extent of the impact, and who will be exposed. In worst condition, people at risk confuse where they should evacuate themselves despite they already know that they are in danger. Similarly, stakeholder who responsible to evacuate people may have difficulties to manage evacuation site during a critical time. To solve this problem, we propose SAFEVolcano i.e. a GIS-based framework for managing evacuation camp selection-allocation considering the dynamic of the volcanic disaster extent.

129 ***A Spatiotemporal Population Subgroup Model of Radiation Exposure***
Becky Martin, David Martin and Samantha Cockings
Understanding the whereabouts of vulnerable population subgroups during emergencies can improve the implementation of countermeasures and incident outcome. This paper uses spatiotemporal population density modelling and atmospheric dispersal modelling to estimate the radiation exposure of a specific population at different times of day, during the start of a hypothetical radiation accident scenario in Exeter, UK. The model outputs are analysed by GIS to discern spatiotemporal trends in population exposure, and to identify the times of day when population subgroups may be most at risk.

6C - UKDS Census Support Session

68 ***The Role of Geographical Context in Building Geodemographic Classifications***
Alexandros Alexiou and Alexander Singleton
Geodemographic analysis is a methodology that can simplify and demonstrate spatial patterns of socio-economic structure. A particular issue of current geodemographics is a lack of geographic context in the clustering process. Within the broad range of geodemographic applications, current techniques arguably smooth away geographic differences between proximal zones, thus limiting classification sensitivity to local contexts. This research begins to address the issue of geographic context by analyzing and evaluating various local, regional and national extents that can be used towards formulating later geographic attribute contextual weights.

104 ***Spatial Analysis of Commuting to Work Intensities and Patterns in England and Wales and the Leeds City Region***

Thomas Murphy

Commuting involves the regular movement of an individual from a place residence to a place of work and back again. The vast majority of individuals in employment are involved in making a commuting journey on a regular, often daily, basis. This behaviour is a relatively important (and often much disliked) part of many peoples routines, with a direct and indirect impact on their lives. One of the key sources of information about commuting intensities and spatial patterns is the population census in the United Kingdom, through which travel to work characteristics are captured resulting in large and complex data sets that are disseminated by the census agencies as aggregate counts (i.e. stocks of commuters based on where they live) or interaction counts (i.e. flows of commuters from where they live to where they work). A number of commuting variables (relating to mode of travel) from the 2011 Census have been released by the Office for National Statistics (ONS) as part of the Aggregate Statistics for England and Wales, whilst the flow data are published independently for the UK as a whole as Special Workplace Statistics (SWS) or Special Travel Statistics in Scotland (STS). This paper reports on analyses of these data sets at two levels. Firstly, data from the Aggregate Statistics (Tables KS015 and CT0015) are used to explore changes in overall commuting intensities and also proportions of commuters by mode of travel (including homeworking) at district level across England and Wales. These data are valuable in providing evidence of stocks of commuters according to where they are usually resident but do not provide information about their workplace destinations. A second set of analyses using interaction flow data from the Origin-Destination Statistics will be reported which identify patterns of commuting within the Leeds City Region (LCR). These data provide counts of commuting outflows from residential areas, inflows to workplace areas and flows between each residential origin and workplace destination. In this case, we will use the LCR as our geographical study area and examine changes in flows at different spatial scales, depending on which flow data from the 2011 Census are released in an accessible form. Choropleth maps are used to show variations in the commuting rates and intensities by district across the nation, whilst flow maps are used to show variations in the magnitudes of commuting flows between the districts and smaller areas at the local level. Ultimately, the findings from the research will support those tasked in local authorities and regional agencies with the responsibility to supply and maintain transport networks for those who require them.

110 ***UK internal migration by ethnicity***

Nik Lomax

Migration is a key component of population change for local authorities in the United Kingdom (UK). This paper assesses internal migration during the first decade of the 2000s, disaggregated by ethnic group, drawing upon data reported in the 2001 and 2011 Censuses and a time series of migration data for years between these censuses estimated by Lomax (2013). The patterns, trends and changes for the decade are identified and mapped and are presented alongside an interpretation and discussion. These internal migration estimates are one component of a wider project tasked with projecting ethnic group populations in the UK (entitled NewETHPOP) and a brief summary of this project and its proposed outcomes will be offered.

123 ***Profiling Burglary in London using Geodemographics***

Chris Gale, Alex Singleton and Paul Longley

A geodemographic classification provides categorical summary class assignments of neighbourhood areas based on salient population characteristics and built environment attributes. The regional London Output Area Classification (LOAC) is an example of such a classification, created using the same methodology as the national 2011 Output Area Classification. Police.uk data coded to LOAC provides an alternative perspective on burglary rates in London, with dwellings in different geodemographic clusters having experienced stark differences in the rate of burglaries. We conclude LOAC benefits from a greater predictive ability when compared to a national classification for differentiating socio-spatial structure, thus providing a more detailed insight into the variations of burglary across London.

126 ***Geodemographics and spatial microsimulation: using survey data to infer health milieu geographies***

Jens Kandt

This paper presents an approach to infer lifestyle milieus from survey microdata as building block of purpose-built geodemographics. 33,000 England and Wales residents have been clustered into nine lifestyle milieus based on a range of behavioural and attitudinal variables. The milieus strongly differ by individual social and demographic circumstances. Spatial microsimulation can be used to estimate probabilistically the geographical distribution of milieus. Preliminary results for London are presented in this abstract, demonstrating how extensive behavioural information of social surveys can be combined with the nearly complete coverage of spatial census data within a geodemographics framework to inform policy interventions.

7A - Cities

19 ***The Influence of Familiarity on Route Choice: Edinburgh as a Case Study***

Maud van Haeren and William Mackaness

Automatically generated routing instructions are provided by Satnav and Internet based mapping services in order to assist us in getting to unfamiliar places. Instructions from these devices are based around least cost algorithms, described on a street- by- street basis. Taking no account of what we might already know, the instructions are long, difficult to remember and require effort to interpret. If we could opportunistically route the person via known areas, the recognition process would be easier, the instructions could be fewer, and the users would find greater comfort in travelling through spaces familiar to them. In this paper we model a users heterogeneous familiarity of the city such that it modifies a cost surface, resulting in directions that route the user via familiar spaces. A familiarity index was created based on historical GPS based trajectories. Participant route choice was found to be closer to outputs from the model than simple shortest path.

50 ***Accessibility-based simulation of urban expansion in Brazil***

Marcus Saraiva, Joana Barros and Maurcio Polidori

This work proposes an urban growth simulation model based on a weighted accessibility measure, which is calculated based on the characteristics of the landscape surrounding the city. Two types of features were considered: natural and human-made. The model was tested for the city of Bag, in the Southern Brazil. The model was largely able to

replicate the urban expansion pattern of the case study, suggesting that the proposed weighted accessibility measure is a suitable way to capture the impact of surrounding areas in the process of urban expansion.

73 ***New approaches to measure the spatial structure(s) of cities***
Daniel Arribas-Bel and Emmanouil Tranos
This paper uses mobile phone data for the city of Amsterdam to study the distribution of activity over space and time. The extent to which we can empirically learn about the spatial structure of cities is limited by the technology and data available at given point in time. Using new sources of data that did not exist only a few years ago and recent statistical approaches that exploit them in a fuller fashion, we are able to obtain a representation of the changing spatial structure of the city over the course of a year, a week and a day.

124 ***Calculating the Overbuilding Potential of Municipal Buildings in London***
Joanna Foster, Claire Ellul and Philippa Wood
The world population is set to increase significantly, with the urban population expected to rise by 72% in the next 40 years from 3.6 billion in 2011 to 6.3 billion by 2050 (Nations, 2012). It is therefore necessary to take into consideration the continuing demands that the growing population is going to place on the citys infrastructure, and make preparations now for the future. This paper focuses on the concept of overbuilding, and calculating the potential solution this may provide to the chronic housing shortage currently faced throughout the UK.

7B - New Methods

5 ***Visualize and interactively design weight matrices***
Angelos Mimis
A GIS tool that permits to visualize, explore and interactively modify weight matrices is described. The weight matrices, created in various formats, can be imported and the spatial relationship, by using polylines, can be visualized. Scripts are developed to explore the structure of the weight matrix by illustrating basic statistics, to illustrate the full matrix and to compare different matrices. The spatial relationship can then be modified (by deleting or adding polylines) and exported in order to further use it in computations. The extension is developed in Python, is based in PySAL and matplotlib libraries and is implemented in ArcGIS.

33 ***A self-exciting point process model for predictive policing: implementation and evaluation***
Gabriel Rosser and Tao Cheng
The self-exciting point process (SEPP) model has recently been shown to perform well in predicting spatiotemporal crime patterns. However, this model has not been widely applied to crime data and many open questions remain about how best to implement it in a real setting. In this work, we consider a range of practical implementation details relating to the application of SEPP models to real crime data. We propose a robust protocol that optimises the performance of the method, and suggest guidelines for parameter selection.

37 ***Comparing Methods: Using Multilevel Modelling and Artificial Neural Networks in the Analysis of House Prices***

Yingyu Feng, Kelvyn Jones and Richard Harris

Two advanced modelling approaches, Multi-Level Models and Artificial Neural Networks are employed to model house prices. These approaches and the standard Hedonic Price Model are compared in terms of predictive accuracy, capability to capture location information, and their explanatory power. These models are applied to house prices in the Greater Bristol area, 2001-2013 using secondary data from the Land Registry, the Population Census and Neighbourhood Statistics so that these models could be applied nationally. The results indicate that MLM offers good predictive accuracy with high explanatory power, especially if neighbourhood effects are explored at multiple spatial scales.

38 ***Assessing geographic data usability in analytical contexts: Undertaking sensitivity analysis of geospatial processes***

Robin Frew, Gary Higgs, Mitchel Langford and Jenny Harding

This paper addresses the continuing dearth of research on spatial data usability by applying sensitivity analysis to GIS-based accessibility models. Comparisons were made using approaches based on Euclidean distances and more sophisticated accessibility measures that utilise travel distances and times: the latter incorporating measures of supply and demand by using innovative extensions to the Enhanced Two-Step Floating Catchment Area method (E2SFCA). To illustrate the sensitivity of findings from applying such models with a range of data sources, accessibility to secondary schools was calculated for Output Areas in South Wales using an E2SFCA plug-in to ArcGIS. By using different permutations of spatial data, for both the supply- and demand-side parameters in such models, differences in FCA scores were sought in order to comment on the usability of such data sources. Preliminary conclusions are made on the appropriateness of such data sets in relation to different types of network-based accessibility modelling tasks.

56 ***Comparing different spatial microsimulation frameworks***

Melanie Tomintz and Bernhard Kosar

Spatial microsimulation modelling was introduced in the 1980s but there is still a lack of open and easy to use frameworks. This obstacle was recognized by researchers and now there are frameworks available to access/download. The aim of this paper is to compare three different spatial microsimulation frameworks, as all of them have different algorithms implemented, that are available for free to the research community. The expected results are to find the best approach to model the Austrian smoking population for municipalities based on Austrian datasets and to list the pros and cons of the frameworks based on defined criteria.

7C - Geodemographics (II)

51 ***A new metric of crime hotspots for operational Policing***

Monsuru Adepeju, Tao Cheng, John Shawe-Taylor and Kate Bowers

This study examines the existing metrics used in evaluating the effectiveness of area-based crime hotspots for operational policing. We identified some of the limitations of the metric (i.e. Area-to-Perimeter (AP) ratio) used for measuring compactness of hotspots and then proposed a new improved metric called Clumpiness Index (CI). The case study of London Metropolitan police crime dataset features the prediction of 3 different crime types using two different crime predictive methods. The effectiveness of

the hotspots was then measured using both AP ratio and CI. The comparison of the results clearly shows that CI is a better metric for measuring the effectiveness of crime hotspots for operational policing.

96 ***A Simultaneous Model forDemographics, Economy and Infrastructure***
Chengchao Zuo and Mark Birkin
This paper reports investigations into the feedback and linkages between demographic change and infrastructure provision. In this paper, we seek to explore the coupled dynamic of demographics, the economy and infrastructure simultaneously as a series of subsystems. The modelling results will explore different policy scenarios for regional infrastructure investment to offer an initial proof of concept of the feasibility of implementing a coupled model of demographic and economic growth over a medium to long time horizon, and promises a distinct and exciting perspective on the co-dynamic interplay of social and economic policies, regional development, infrastructure provision and prosperity.

111 ***Inequality in access to education, and inequality in access to information about allocation of school places***
Oliver Duke-Williams, Elizabeth Shepherd and Alexandra Eveleigh
The process of allocation of school places generates administrative data that can be used to explore ideas about access to education, and to allow parents / guardians to make a more informed choice when applying for school places for children. A case study explores changing patterns of pseudo catchment areas in the London Borough of Waltham Forest, and illustrates difficulties of assembling some of the relevant data. Similar analysis in carried out for other local authorities, and it is shown that the amount of data available and the ease with which it can be retrieved varies considerably between authorities.

116 ***A Visual, Statistically Robust Anomaly Detector For Migration Data***
Chris Brunsdon and Aidan Slingsby
There is a lack of statistical theory used in cartography that often results in thematic maps containing some data that are not statistically robust. A recent study that considered geographical gender migration differences in 19th Century Ireland, suggested using the chi-statistic to remove values that were not statistically significant. Here, we avoid this crude sharp cut-off, using statistical theory to produce an index that combines the value of interest with its statistical robustness. This deemphasises, rather than obliterates, less robust data, enabling interpretations on data of various statistical robustnesses.

128 ***Learning Lessons from Population Projections: How Well Did We Forecast the Ethnic Transition?***
Philip Rees and Pia Wohland
Population projections are rarely evaluated. Yet evaluations are an essential means for understanding how projections depart from reality. In this paper we describe a set of local population projections by ethnicity for England, based on the 2001 Census population, which can be compared after 10 years with the results of the 2011 Census. We examine the differences at national and local levels and for broad and detailed aggregate groups. Some differences are small such as the all group population of England but others are very large such as the populations of Other Ethnicity, indicating considerable uncertainty about the components of change estimated for 2001 to 2006

and the projection assumptions for 2006 to 2011. By looking at the ethnic-local differences by age and by geographic pattern we can make some deductions about the sources of error. These lessons enable us to plan a set of simulations with a new version of our projection model over 2001 to 2011 that can isolate more precisely the reasons for the 2011 projection versus 2011 census differences. This analysis will help improve the next round of ethnic population projections upon which we are currently engaged.

8A - GIS and the Environment (II)

9 ***Constrained clustering of the precipitation regime in Greece***
Eftychia Rousi, Christina Anagnostopoulou, Angelos Mimis and Marianthi Stamou
The aim of this paper is an objective clustering of the precipitation regime in Greece. The data consists of winter daily precipitation values obtained from a Regional Climate Model, the RACMO2/KNMI, for the period 1971-2000. The constrained clustering method is implemented by using three different linkages, single, complete and average, and for three different cluster numbers, 10, 20 and 30. Average and complete linkage both performed well, with the latter proving to be more detailed and its spatial resolution presents many similarities to the original data. The 20 and 30 clusters are clearly more representative than the 10 cluster results.

69 ***Visualisation of Spread of Chalara Ash Dieback for Raising Public Awareness and Responsible Woodland Access***
Chen Wang, David Miller, Paula Horne, Yang Jiang, Gillian Donaldson-Selby and Jane Morrice
A 3D model of ash (Fraxinus excelsior) woodland was developed to present information on the symptoms and spread of Chalara ash dieback (Chalara fraxinea) as part of a knowledge exchange programme for the Scottish Tree Health Advisory Group. A hypothetical woodland was designed, with characteristics of the vegetation and topography of a site in north-west Scotland. A model of different stages of infection was prepared and represented in a virtual environment. This was presented to audiences in Edinburgh and Aberdeen, and feedback on experiences and understanding of the disease provided to the team monitoring and advising on the disease outbreak.

86 ***Characterisation and Classification of Hydrological Catchments in Alberta, Canada Using Growing Self-Organising Maps***
Michael Allchin
Operational hydrologists are often required to transfer information from well-understood instrumented research basins to wild catchments for which few details are available. To do so successfully, the climatological inputs and physiographic processing in both must be sufficiently similar that their resultant flow regimes will also be comparable. This is challenging to determine, because of the wide variety of influences on hydrological response, and the degree of heterogeneity among and within catchments. Pattern recognition or classification can help with this. This study explores the application of Growing Self-Organising Maps, a data-mining technique based on unsupervised machine learning, for this purpose.

106 ***Integrating BIM and GIS : Exploring the use of IFC space objects and boundaries***
Gareth Boyes, Charles Thomson and Claire Ellul
In GIS, understanding the layout of interior spaces has important applications in the analysis of energy efficiency, indoor navigation and atmospheric pollution. However,

detailed models of building internals are usually held in engineering or architecture software, including Building Information Modelling (BIM) software such as Autodesk Revit, and are not easily understood by GIS in this format. Additionally, such models contain excessive detail, such as wall thickness, not required for GIS operations such as topological adjacency. This paper describes the process required to convert BIM data into GIS, addressing both conceptual modelling and data format differences.

8B - Retail Science

34 ***A national-scale application of the Huff gravity model for the estimation of town centre retail catchment area***

Michail Pavlis, Les Dolega and Alexander Singleton

This work presents the application of an unconstrained retail gravity model based on the Huff algorithm. The main objective of the analysis was to estimate the retail catchment areas for town centres in England as a function of relative attractiveness and distance from potential customers, while taking into account the effects of competition among the retail destinations. This was achieved by relaxing the areal constraint for spatial interactions, allowing thus the relative size and attractiveness of the town centres to define the scale at which competition might occur.

78 ***Designing a location model for face to face and on-line retailing for the UK grocery market***

Elena Kirby-Hawkins, Graham Clarke and Mark Birkin

The aim of this paper is to explore the patterns of e-commerce sales in Yorkshire and Humberside area and use this analysis for building and testing of a retail location model which can estimate local and regional sales both at physical stores and for internet sales. This is important for retailers as future geographical growth is likely to be driven by a mixture of new stores and e-commerce. This study creates an unique opportunity for the retailers to develop innovative site location techniques to estimate instore and online sales which will then help drive future regional growth models.

91 ***Retail Modelling in Tourist Resorts: A case study of Looe, Cornwall***

Andy Newing, Graham Clarke and Martin Clarke

We demonstrate that applied retail modelling can be used to support retail planning and location based decision making within highly seasonal tourist resorts. Using small area spatiotemporal demand estimates and a custom built Spatial Interaction Model (SIM), we evaluate a live retail development scheme. Our modelling approach can be used to estimate store revenue and to identify the impact of supply side changes on consumer flows, store and retailer market shares and network performance in order to support the retail planning process.

97 ***Exploring the role of consumer data for food in national survey reporting***

Michelle Morris, Graham Clarke and Mark Birkin

National data collected to aid understanding of spending patterns associated with food consumption and nutrition in the UK are reported in the Family Food module of the Living Costs and Food Survey. This survey data is used to better understand our society, including the geographies of food spending and informs the Consumer Price Indices. Such surveys require a nationally representative sample of volunteers to report their food spending and consumption patterns. This paper explores the role in which big data relating to food purchases could supplement such surveys and how reports using consumer data compare to survey data geographically.

121 ***Temporal profile of daily sales in retail stores in London***
Syed Rakib Uddin and Professor Paul Longley
This project will explore the temporal variation of daily sales by key Stock Keeping Unit (SKU) groups in various retail stores in London. Daily sales data is obtained from a major UK retailer which has hundreds of retail stores in the UK. The aim of the study is to identify distinguishable temporal patterns in sales behaviour between various types of stores in London and to detect and explain outliers. It would also answer broad questions such as when customer congestion is most likely to occur, how stock can be redistributed during lunch hours and evenings in various retail stores.

8C - Social Media

41 ***Exploring the geo-temporal patterns of the Twitter messages***
Muhammad Adnan, Guy Lansley and Paul Longley
This paper explores the data recorded through the Twitter social media service. In particular we are interested in the analysis of the content of Tweet messages. A large corpus of Twitter messages was analyzed and Index of Dissimilarity measure was used to identify interesting words having spatial concentrations. The paper presents an initial exploration of the spatial and temporal pattern of the identified interesting words. At the finest geographical level, this type of analysis can gage very useful information to local planners in general and retail planners in particular.

52 ***Football fan locality- An analysis of football fans tweet locations***
Neil Harris and Phil James
This paper looks at the validity of using social media as a dataset for spatial analysis and demonstrates the use of geo-located tweets to investigate the locality of football club fan-bases

89 ***Can the sentiment expressed in trail users' tweets help to assess the effectiveness of Environmental Stewardship Agreements? An exploratory analysis of the Pennine Way National Trail, England.***
Tom Wilson and Robin Lovelace
This paper presents an exploratory analysis into the feasibility of using the sentiment expressed within trail users' Twitter messages to assess the effectiveness of Environmental Stewardship Scheme agreements in place along the Pennine Way National Trail, England.

115 ***Using Mobile Phone Traces to Understand Activity and Mobility in Dakar, Senegal***
Ed Manley, Adam Dennett and Michael Batty
With the emergence of mobile phone trace datasets, new opportunities have arisen for improving the understanding large-scale mobility behaviours. The potential impact of these insight derived from these data is no more significant than in the developing country context, where existing data collection infrastructure is limited or non-existent. In this research, mobile phone data for Dakar, Senegal is used to better understand urban activity and mobility dynamics. To achieve this, a clustering method is introduced that extracts the spatial distribution, and the temporal characteristics, of the activities of individual mobile phone users. With this classification of individual locations of activity, citywide trends in activity and mobility over time are derived. The paper concludes in discussing the potential and limitations of this approach, and the outlook for associated analyses that employ mobile phone trace data.

Poster session

1 ***Mapping terrorist activities in Central Asia: Regional view on domestic issue 1990-2012***

Andre Python and Aliya Tskhay

In the discussion of terrorist threat in Central Asian region, limited studies have been conducted on understanding the location of terrorist attacks. The study applies innovative approach and explores high-resolution spatial data on terrorist attacks in the region and more specifically on the ethnic dimension of the issue. The use of Klier-McMillen linearized Generalised Method of Moments (GMM) spatial logit model unveils intriguing connections between terrorist activities and ethnic composition of the region and allows the identification and modelling of fine-scale interactions between various covariates and the occurrence and intensity of terrorist attacks in Central Asia.

10 ***Mapping the Health and Crime Nexus Using Spatial Video and Geonarratives: Examples from the United States***

Andrew Curtis, Eric Eric Jefferis, Lauren Porter and Eric Shook

The geographic analysis of health or crime events, such as the location of prostitution (and related diseases), the interaction between drugs and the built environment (including overdoses and important spaces), and different expressions of street-level violence present a complex problem often limited by data availability. Current trends in both health and crime analysis are to break apart the spatial nuance within a hotspot in terms of micro places. The justification is compelling, it is important to contextualize the buildings, streets, spaces and experiences of those who live in the problematic area. This poster will present a spatial video approach that can be used to capture typically unavailable ephemeral fine scale data, across multiple time periods for a dynamic urban landscape, and from multiple experts in the form of geonarratives, which is an environment inspired dialogue. The insights of residents, volunteers and professionals can be used to describe the context and importance of buildings, streets, corners, and the perceived impact of different interventions. This poster will present a standardized methodology for what until now has largely been an experimental concept. Using Akron, Ohio, and Los Angeles, California as study spaces, multiple geonarratives will be combined to provide a comprehensive bottom-up understanding of the crime-health nexus. Perspectives from community police, ex-offenders, and local residents will narrate the landscape before their insights are dissected for spatial content and then mapped in association with more traditional data layers (such as 911 call for service). This poster will describe the methodology involved, the protocols that will result in a successful geonarrative, and how these spatially encoded textual streams can be mapped and analyzed.

12 ***The Utility of Spatial Video for Assessing Risk in Challenging Environments: A Case Study of Cholera in Haiti***

Andrew Curtis, Jason Blackburn, Sarah Smiley, Afsar Ali and John Glenn Morris

Fine-scale and longitudinal geospatial analysis of health risks in challenging urban areas is often limited by the lack of available spatial data. Underlying population counts, residential context, and associated causative factors such as standing water or trash locations are often missing unless collected through logistically difficult surveys. The lack of spatial context also hinders designing intervention strategies structured around analytical insights. This paper offers a spatial video approach that can be used to improve analysis and involve participatory collaborations. The case study presented

involves water-related risks in post-earthquake Haiti. Spatial video is used to collect environmental data such as standing water, trash accumulation, presence of dogs, cohort specific population characteristics and general activity spaces. These data are digitized into Google Earth and then coded and analyzed in a GIS using different local area spatial analysis methods. These layers can easily be temporally updated to capture fine scale dynamism in the landscape. An example is provided of how these risk maps were used to guide water testing strategies in a coastal town previously impacted by cholera. The poster will describe how the simplicity and flexibility of the technique means data can be collected by vehicle, by boat, or using a hand-held unit. All data is archived through the map, allowing for easy access which facilitates training, intervention planning and coding-analysis validation. To summarize, spatial video is a tool that can be used in most environments to improve local area health analysis and intervention. The process is rapid and can be repeated in study sites through time to track spatio-temporal dynamics of the communities. Its simplicity also encourages local participatory collaborations.

29 ***Understanding Environmental Perceptions and Behaviors through use of Geospatial Technologies: Implications for Health Impact Assessments (HIAs)***

Jacqueline Curtis and Kim Gilhuly

Health Impact Assessments (HIAs) are an accepted approach to understand the potential health outcomes created by a specific planning or policy initiative. Internationally, they are supported by the World Health Organization (WHO) and in the United States they are promoted by the Centers for Disease Control and Prevention (CDC). HIAs are typically directed by public health departments with consultation from local government officials and input from community members. Despite its limited use in the HIA process, there are numerous opportunities for integration of geospatial technologies to provide insights throughout the assessment. The objectives of this poster are to a) provide an overview of how geospatial technologies can be more widely incorporated into the HIA process and b) report on their use for understanding resident environmental perceptions and behaviors in three different HIAs in the United States.

59 ***Telling the Story of Globalisation through an Integration and Analysis of Big Data sets***

Anthonia Ijeoma Onyeahialam and Michael Woods

My research investigates the role rural areas play in the globalisation process through analysing, mapping and visualising a facet of themes. I examine migration patterns that include amenity and labour migration routes, trade and business networks of entrepreneurs, agriculture and food with examples in exports and imports, commodity chains, foot prints and supply chains of supermarkets, TNCs (eg Tesco, Laura Ashley and mining corporations, fishing, sugar and wool assemblages), diffusion of wine technologies, social media connections, fishing, land grabbing, health and tourism. With my research dating as far as the 19th century with case studies in Newtown, Wales, Australia, China, Sweden, New Zealand and Canada, I rely on data characterised by the three Vs of big data: volume, velocity and variety. I utilise quantitative and qualitative secondary data from national and international data archives as well as primary sources like narratives from oral histories, interviews, surveys, newspaper records, media reports, archives and document research. I present efforts using spatial only and time space methodologies to process, analyse, map, visualise and narrate globalisation stories of rural areas. This includes the difficulties in undertaking this research.

67 ***Exploring the usefulness of transport Spatial Tweets from big events: A case study of 2014 Commonwealth Games***

Godwin Yeboah, Caitlin Cottrill, Paul Edward Gault, John Nelson, Jillian Anable and David Corsar

The future of GIS within the context of Big Data from social media platforms, such as Twitter, potentially depends on the possibility to capture, analyse, and make sense of the spatial component of Tweets. This study presents a case study which explores millions of transport related tweets from 2014 Commonwealth Games with the aim of understanding the usefulness, or non-usefulness, of the spatial component of the tweets. The overarching question, within the context of big data, is that - are spatial tweets for big events useful, or not useful, for transport research?

80 ***High-Street Resilience and Social Media Opinion Mining***

Alyson Lloyd, James Cheshire and Helena Titheridge

This research focuses on the usefulness of social media opinion mining in the retail sector and what constitutes an attractive high-street retail centre from the viewpoint of a consumer. Geo-located Twitter data allows us to establish when, where and what people say about different retail centres. Comparing this data with retail centres of differing vitality could allow us to draw conclusions about how useful and predictive this source could be. Initial analysis revealed some contrasting text content within top ranked and bottom ranked retail centres in Greater London.

88 ***Exploring the sentiment of trail users' tweets.***

Tom Wilson and Robin Lovelace

This poster presents the initial findings into an exploratory analysis of the feasibility of using the sentiment expressed within trail users' Twitter messages to assess the effectiveness of Environmental Stewardship Scheme agreements in place along the Pennine Way National Trail, England.

93 ***The Social Distribution of Ecosystem Services under Land-Use Change in England***

Karen Mullin

The dependency of human wellbeing on nature is widely acknowledged, however, rapid population growth in England has led to considerable change in land use and the spatial distribution of ecosystem services. The proposed research seeks to understand if the change in provision of ecosystem services nationally from 2001-2011 has been socially just. The research will model the distribution of ecosystem services, establish who the winners and losers have been and what planning strategies have been implemented. Ultimately, this will inform recommendations for policy to maximise socially just delivery of ecosystem services in the context of increasing land-use pressures.

94 ***Parallel computation for accessibility based planning support***

Jianquan Cheng, Jianguang Tu and Liangxiu Han

Involving stakeholders in decision-making at workshops requires a computer system to respond quickly to various scenarios proposed by participants. Due to the increasing complexity of urban systems, such planning support often faces the challenges of big data and poor computational performance. This paper proposes a new approach using parallel processing techniques (i.e. MPI Message Passing Interface) to support workshop participants in interactively building planning scenarios and visualising outputs of job accessibility across Greater Manchester. MPI-based parallel algorithms have been run on a cluster of computers for reducing computational time cost. The results and

performances are critically evaluated and recommendations for future work provided.

108 ***A Methodology for Assessment of Rooftop Solar Potential for Widely Distributed Property Holdings: Challenges, Lessons Learned and Future Directions***
Andrew Miles and Lesley Browne
A methodology has been developed to enable detailed assessments of rooftop solar potential to be carried out for large numbers of buildings, distributed across very wide areas (regional or national scale). This process is driven primarily by high resolution elevation data and small scale vector mapping data, integrated into a geoprocessing model in order to analyse widely distributed buildings in an iterative fashion. Work so far has produced a viable model for assessing rooftops across England and Wales, but has also identified a number of avenues for improvement both in terms of the efficiency of the methodology and the accuracy of its outputs.

117 ***Understanding health expectancy inequalities across local areas in England and Wales***
Pia Wohland, Seraphim Alvanides and Carol Jagger
The population of the UK is aging. At the same time the UK is renowned for health and mortality inequalities across the country and some studies suggest that this gap is widening. This study explores health inequalities in disability free live expectancy (DFLE) and healthy life expectancy (HLE). We identify socio-economic and socio-demographic factors explaining the variation in HLE and DFLE across England in 2001 and whether they affect DFLE and HLE the same way. In addition, we explore how inequality within a local area affects the overall health expectancy of an area; our hypothesis is that unequal areas are more health disadvantaged than more equal areas.

130 ***Evaluating Pedestrian Routes***
Ebiteme Botu, Jia Wang and Michael Worboys
Pedestrians require more detailed information about factors such as safety, accessibility, distance and duration for routes. However, existing navigation services lack such information. In order to fill this void, we propose a set of six criteria that can be used to evaluate the appropriateness of pedestrian routes. We also provide examples to illustrate our study.

131 ***The Spatial Analysis of Motor Vehicle Theft Patterns in Riyadh, Saudi Arabia***
Nawaf Alotaibi, Nick Malleson, Andy Evans and Alison Heppenstall
In Saudi Arabia, the few studies that have emerged to investigate the occurrence of crime from a geographical perspective suffer from shortages of particular theories, perspectives, data and methods. In short they lack appropriate contextualisation. Moreover, though motor vehicle theft (MVT) has accounted for the largest proportion of property crime incidents for decades in Saudi Arabia, particularly in Riyadh, to date few studies have been conducted to investigate this crime. Those that have, primarily focused on the characteristics of car thieves, and most have overlooked any spatio-temporal distribution of MVT incidents. The overall findings of an initial data analysis indicate that spatial patterns of MVT in Riyadh are both more clustered than randomly distributed events and statistically significant. This preliminary work suggests that this phenomenon needs to be further examined in greater depth and additionally contextualised within the theoretical frameworks developed in environmental criminology theories. These two approaches combined will provide a more detailed understanding of the relationship between MVT incidents and the characteristics of neighbourhoods.

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