The European Colloquium on Theoretical and Quantitative Geography (ECTQG)

7-11 September 2017
York, UK

LEEDS *Institute for Data Analytics*

UNIVERSITY OF LEEDS

Consumer Data Research Centre

An ESRC Data Investment

Welcome to the 2017 European Colloquium on Theoretical and Quantitative Geography (2017), organised by the School of Geography and the Leeds Institute for Data Analytics (University of Leeds).

It is a great delight to welcome you to York; a city that was established 2,000 years ago, and has been a substantial human settlement for considerably longer. For those of you with an appetite for history, the Roman Walls, Minster, Railway Museum, and Shambles may be among many sites of interest. For those of a more gregarious persuasion, then the many bars and restaurants of the city and riverside may be more appealing!

The School of Geography at the University of Leeds is somewhat less ancient than the city of York. Nevertheless, we have a long tradition as a centre for research in spatial analysis and quantitative methods, and after many years of participation in the ECQTG we are proud to host you in Yorkshire for the first time. We hope you will find stimulation as ever in the presentations and conversation with acquaintances old and new.

It is a special pleasure to welcome our old friend and mentor Professor Sir Alan Wilson as a keynote speaker. In half a century since the landmark publications of the 1960s, Alan's influence on the discipline has been peerless. We hope that you will especially enjoy the sessions that have been set aside for the appreciation of Alan's work, and will join in lively discussions about its continuing impact and legacy for the future.

Welcoming you to the conference at this time is also particularly exciting for the organising committee because we have recently been awarded substantial funding to create the Consumer Data Research Centre (CRDC) and, to support this initiative, the University of Leeds has also invested heavily in the new Leeds Institute for Data Analytics (LIDA). These programmes aim to bring together diverse groups of academics, businesses, and policy makers to work on critical geographical social issues. As such, the ECTQG is one of the most relevant and important fora for our work.

Best wishes,

Mark Birkin, Michelle Morris, Nick Malleson

(ECTQG Local organising committee)

Conference timetable

Date	Time	Activity
Thursday 7th September 2017	16:00 - 19:00	Registration
	20:00	Buffet dinner
Friday 8th September 2017	09:00 - 10:30	Keynote 1 - Professor Sir Alan Wilson
	10:30 - 11:00	Coffee
	11:00 - 12:30	Special Session – Spatial Interaction Modelling
	12:30 - 13:30	Lunch
	13:30 - 15:00	Parallel session 1
	15:00 - 15:30	Coffee
	15:30 - 17:00	Parallel session 2
	17:00 - 18:30	Break
	18:30 - 19:30	Special session – Big data and Obesity
	19:00	Buffet dinner
Saturday 9th September 2017	09:00 - 10:30	Keynote 2 – Professor Paul Longley
	10:30 - 11:00	Coffee
	11:00 - 12:30	Parallel session 3
	12:30 - 13:30	Lunch
	13:30 - 15:00	Parallel session 4
	15:00 - 15:30	Coffee
	15:30 - 17:00	Parallel session 5
	19:00	Conference dinner - National Railway Museum
Sunday 10th September 2017	10:30 - 12:00	Parallel session 6
	12:00 - 13:00	Lunch
	13:00 - 14:30	Keynote 3 - Professor Anne Vernez Moudon
	14:30 - 18:00	Field trip
	19:00	Buffet dinner
Monday 11th September 2017	09:00 - 10:30	Parallel session 7
	10:30 - 11:00	Coffee
	11:00 - 12:30	Parallel session 8
	12:30 - 13:30	Lunch
	13:30 - 15:00	Keynote 4 - Professor Chris Brunsdon
	15:00	Depart

Useful Information

Registration Desk

The registration desk will be open from 4pm – 7pm on Thursday 7th, 9am – 3pm on Friday 8th, Saturday 9th and Sunday 10th, and 9am to conference close on Monday 11th September. If at any point you have any queries, do come to the registration desk or grab one of the conference organising committee.

Field trip

We will be going on a guided tour of York on Sunday afternoon with the Association of Voluntary Guides to the City of York. If you will be coming along, please meet in the foyer of the hotel at 2.45pm to walk to the start of the walk. There will be a note posted on the registration desk of the starting point of the walk, so if you want to make your own way, please check there for the meeting point in York.

Conference Dinner

The conference dinner will be taking place on Saturday evening, at the National Railway Museum. The venue is a short walk from the Park Inn, but those who would like to walk down together, do meet us in the foyer of the hotel at 6.45pm.

Wifi

Please come to the registration desk for wifi details.

Luggage

Luggage may be left at the Park Inn reception.

Keynote Speaker Biographies

Sir Alan Wilson FBA, FAcSS, FRS is Chief Executive of the Alan Turing Institute and Professor of Urban and Regional Systems in the Centre for Advanced Spatial Analysis at University College London. He is Chair of the Home Office Science Advisory Council.

He was responsible for the introduction of a number of model building techniques which are now in common use internationally – such as the use of 'entropy' in building spatial interaction models; summarised in *Entropy in Urban and Regional Modelling*. His current research is on the evolution of cities and global dynamics. He writes the Quaestio blog on research and interdisciplinarity.

He was Vice-Chancellor of the University of Leeds from 1991 to 2004 when he became Director-General for Higher Education in the then DfES. From 2007-2013 he was Chair of the Arts and Humanities Research Council and from 2013-2015, of the Lead Expert Group for the Government Office for Science Foresight Project on The Future of Cities.

He is a Member of Academia Europaea, an FBA, an FAcSS and an FRS. He was knighted in 2001. His recent books include *Knowledge Power* (2010), *The Science of Cities and Regions* (2012), his five volume (edited) *Urban Modelling* (2012), (with Joel Dearden) *Explorations in Urban and Regional Dynamics* (2015) and two edited volumes, *Global Dynamics* and *Geo-mathematical modelling* (2016).

Paul Longley B.Sc., Ph.D., D.Sc., FAcSS. holds a chair in Geographic Information Science at University College London (UCL), UK. His research interests are in Geographic Information Science and Systems, and he is a co-author of a best-selling book on this subject. He has worked as PI of Co-I on more than 50 research grants totalling over £20 million and has supervised more than 50 Ph.D. students (most funded by research councils). His publications include nineteen books, and over 150 refereed journal articles and contributions to edited collections. He currently directs the *Consumer Data Research Centre* at UCL. His academic and editorial Duties include past editorship of *Computers, Environment and Urban Systems* and *Environment and Planning B*. He has also held eleven externally funded visiting appointments and given more than 150 conference presentations and external seminars.

Anne Vernez Moudon is Professor Emerita of Architecture, Landscape Architecture, and Urban Design and Planning; Adjunct Professor of Epidemiology and Civil and Environmental Engineering at the University of Washington, Seattle, where she also directs the Urban Form Lab (UFL). Prof. Vernez Moudon's published works include *Built for Change: Neighborhood Architecture in San Francisco* (MIT Press 1986), *Public Streets for Public Use* (Columbia University Press 1991), and *Monitoring Land Supply with Geographic Information Systems* (with M. Hubner, John Wiley & Sons, 2000). Her recent publications on built environment and behaviour are in transport and health journals.

Chris Brunsdon is a Professor of Geocomputation and Director of the National Centre for Geocomputation at Maynooth University, Ireland. Prior to this he was a Professor of Human Geography at the University of Liverpool in the UK, and before this he worked in the Universities of Leicester, Glamorgan and Newcastle. He has degrees from Durham University (BSc Mathematics) and Newcastle University (MSc Medical Statistics, PhD in Geography).
His most recent books include *Geocomputation: A Practical Primer* (with Alex Singleton, 2015) and *An Introduction to R for Spatial Analysis and Mapping* (with Alexis Comber, 2015).

Session Overview

Friday 8th September

Time	Room 1	Room 2
09:00 - 10:30	**Keynote 1 - Professor Sir Alan Wilson**	
10:30 - 11:00	Coffee	
11:00 - 12:30	**Alan Wilson Plenary** **Spatial Interaction Modelling Symposium** **Chair: Mark Birkin** 1. *John Stillwell* Comparing Distance and its Frictional Effect on Internal Migration in Countries Around the World 2. *Frank Southworth* A Look at Freight Demand Modeling in the United States 3. *Martin Clarke* Numerical Experiments: exploring the properties of spatial interaction models using real and imaginary data 4. *Mark Birkin* A family of spatial interaction modellers 5. *Michael Batty*	

Time	Room 1	Room 2
	Scaling from Spatial Interaction	
12:30 - 13:30	**Lunch**	
13:30 - 15:00	**Parallel session 1**	
	1A - Environment and Health **Chair: Emma Wilkins** 1. *Sonia Trabelsi; Isabelle Thomas* On measuring "green": a comparative analysis of four databases in Namur (Belgium) 2. *Geoffrey Caruso; Marion Le Texier; Mirjam Schindler* The Green Mismatch Hypothesis: concept framing and empirical views from Brussels, Luxembourg and Rouen. 3. *Marlene Boura* How does the spatial distribution of green within cities impact carbon uptake? 4. *Thierry Feuillet; Hadrien Commenges; Mehdi Menai; Helene Charreire; Emmanuelle Kesse-Guyot; Romain Reuillon; Julie-Anne Nazare; Serge Hercberg; Jean-Michel Oppert* Why do I walk here? Computing a large scale GWR for hierarchising the environmental correlates of walking in France	**1B – Mobility** **Chair: Emily Sheard** 1. *Robin Lovelace* Implementing spatial interaction models: from prototype to globally scalable tools 2. *Jean-Pierre Nicolas; Nicolas Pele; Cyrille Francois* Urban Form and Daily Mobility Interactions: an Analysis of Socioeconomic and Environmental Impacts Thanks to LUTI Model Simulations 3. *Nick Malleson; Susan Grant-Muller; Frances Hodgson; Gillian Harrison* Quantifying Personal Pollution Impacts to Inform Transport Scheme Innovation through New Generation Mobility Data 4. *Larissa Silva Lopes; Benjamin Motte-Baumvol; Thomas Thevenin* Urban mobility and the spatial distribution of economic activities in Rio de Janeiro
15:00 - 15:30	**Coffee**	

Time	Room 1	Room 2
15:30 - 17:00	Parallel session 2	
	2A - Health and Lifestyle **Chair: Michelle Morris** 1. *Paul Williamson; Xin Gu; Karyn Morrissey; Ferran Espuny-Pujol* Small-area estimation of comorbidity: an indirect survey calibration approach 2. *Emma Wilkins; Michelle Morris; Duncan Radley; Claire Griffiths* Geographic variation in the validity of two sources of secondary food environment data 3. *Elena Guk* Modelling of the territorial tourist and recreational system of Norilsk Region 4. *Nik Lomax; Michelle Morris* Assessing activity levels of individuals in a large, self-selecting dataset 5. *Rachel Oldroyd; Mark Birkin; Michelle Morris* The use of non-traditional data for monitoring foodborne illness: methodological recommendations and considerations	**2B - Spatial analysis: Applications** **Chair: Denise Pumain** 1. *Nir Fulman; Itzhak Benenson* Why Do We Search for Parking for So Long? 2. *Yonatan Shaham; Itzhak Benenson* Modeling City-Scale Fire Spread in Mediterranean and Middle Eastern Cities 3. *Maxime Colomb; Mickael Brasebin; Julien Perret; Tannier Cecile* Simulation of a realistic residential development with the integration of two existing models 4. *Milana Glebova* Structural and spatial change in electrical industry of the UK in the beginning of 21 century 5. *Hadrien Fouillade Orsini* Crimes location within spatial patterns insuing by motorized network in Marseille (Southern France)
18:30 - 19:30	**Special session – Big data and Obesity** Presentations from the ESRC Strategic Network for Obesity members **Chair: Mark Birkin**	

Time	Room 1	Room 2
	1. *Michelle Morris, Mark Birkin* What is the ESRC Strategic Network for Obesity? 2. *Duncan Radley; Kate Timmins; Mark Green; Jamie Pearce* Can 'big data' contribute where traditional research falls short? A review of big data usage in obesity research 3. *Emma Wilkins; Mark Birkin; Claire Griffiths; Michelle Morris* Can big data solve a big problem: the obesity data landscape? 4. *Thomas Burgoine: Pablo Monsivais* Development of data-driven tools for policy makers: The Food environment assessment tool (Feat) as a case study	
19:30	**Buffet dinner**	

Saturday 9th September

Time	Room 1	Room 2
09:00 - 10:30	**Keynote 2 - Professor Paul Longley**	
10:30 - 11:00	Coffee	
	Parallel session 3	
11:00 - 12:30	**3A - Geography and economics 1** **Chair: Juste Raimbault** *1. Mehdi Bida; Celine Rozenblat; Elfie Swerts* Modeling hierarchy and specialization of a system of cities as a result of the dynamics of firms' interactions *2. Denise Pumain* From theory to modeling: which economics for evolutionary geography? *3. Antonin Bergeaud; Simon Ray* Adjustment costs and factor demand: new evidence from firms' real estate *4. Clementine Cottineau; Elsa Arcaute; Max Nathan* Geoindustrial clustering of London businesses: modelling firms' trajectories and their interaction with the urban fabric	**3B - Spatial Analysis: Clustering** **Chair: Chris Brunsdon** *1. Richard Harris; Dewi Owen; Rory Kramer* Modelling Processes of Urban Ethnic Desegregation using Multilevel Indices of Segregation *2. Roger Bivand; David Wong* Comparing implementations of global and local indicators of spatial association *3. Emily Sheard; Nick Malleson; Mark Birkin* Exploring the Spatio-Temporal Distribution of Car Key Burglary in West Yorkshire: Routine Activity or Planned Behaviour? *4. Peter Mandl* Geographical Concepts and Reflections about Aspects of the "Digital Age" *5. Matthew Daws* Self-excited point process patterns in crime data

Time	Room 1	Room 2
12:30 - 13:30	Lunch	
13:30 - 15:00	**Parallel session 4**	
	4A - Geography and economics 2 **Chair: Juste Raimbault** 1. *Juste Raimbault* Invisible Bridges? Scientific landscapes around similar objects studied from Economics and Geography perspectives 2. *Olivier Finance* Transnational investment decisions in and towards Europe: evidences for a single European system of cities? 3. *Justin Delloye; Remi Lemoy; Geoffrey Caruso* Homothetic Scaling of Urban Land Use and Population Density Profiles in Monocentric Models 4. *Roger White; Gustavo Recio; Wolfgang Banzhaf* The Necessity of Disequilibrium	**4B - Spatial Analysis: Visualisation** **Chair: Martin Charlton** 1. *Robin Cura; Cecile Tannier* Visual and semi-automated exploration of an archaeological model: calibrating a model of spatial reorganization in North-Western Europe, A.D. 800 to 1100. 2. *Pierre Frankhauser; Olivier Bonin* Error terms and uncertainty in fractal radial analysis 3. *Alessandro Araldi; Giovanni Fusco* Retail Activity and the City: Contribution from the Analysis of Urban Fabrics 4. *Martin Charlton; Chris Brunsdon* Using animation to visualise correlation structure in multivariate spatial data 5. *Monsuru Adepeju* Developing a hybrid hotspot approach for improving the accuracy of crime prediction
15:00 - 15:30	**Coffee**	

Time	Room 1	Room 2
15:30 - 17:00	Parallel session 5	
	5A - Geography and economics 3	**5B - Textual Big data**
	Chair: Juste Raimbault	**Chair: Rachel Oldroyd**
	1. *Eric Koomen; Diogo Vasco* Bridging geography and economics in local-scale land-use modelling	1. *Francoise Lucchini; Leny Grassot; Julien Baudry; Olivier Gillet; Bernard Elissalde* Social networks, events and cities
	2. *Zahratu Shabrina; Elsa Arcaute; Richard Milton; Michael Batty* Modelling Accessibility of Airbnb in Greater London Area	2. *Marion Maisonobe; Laurent Jegou; Beatrice Milard; Michel Grossetti; Denis Eckert* The world geography of scientific visibility: a deconcentration process (1999-2012)
	3. *Joris Beckers; Ivan Dario Cardenas Barbosa; Ann Verhetsel* Modelling the urban layer in B2C e-commerce distribution networks	3. *Denis Eckert; Marion Maisonobe; John Harrison; Francis Harvey* The evolving geography of academic places in France, Germany, and the UK (1999-2014)
	4. *Discussion and special session roundup*	4. *Caterina De Lucia; Mark Bartlett; Pasquale Balena; Pasquale Pazienza; Diana Caporale* Modelling the gap between tourist preferences and local knowledge as drivers of touristic attractiveness
19:00	**Conference dinner - National Railway Museum**	

Sunday 10th September

Time	Room 1	Room 2
	Parallel session 6	
10:30 – 12:00	**6A - Urban systems** **Chair: Roger White** 1. *Gaetan Montero; Cecile Tannier; Isabelle Thomas* On urban boundaries: three methods, three solutions for Brussels 2. *Pavel P. Em* Is there any link between fractal dimension and service companies' entropy in Moscow and Seoul 3. *Giovanni Fusco; Alessandro Araldi* Multiple Fabric Assessment: Exploring the Forms of a Metropolitan Area. 4. *Brano Glumac; Marcos Herrera Gomez; Julien Licheron* A residential land price index for Luxembourg: Dealing with the spatial dimension 5. *Dani Broitman; Eric Koomen* Living in historic cities: Intensification and increasing density gradients	**6B – Accessibility** **Chair: Nik Lomax** 1. *Cyrille Medard de Chardon* Detecting optimal cut-through locations to increase pedestrian and cycling modal shares 2. *Olivier Bonin; Pierre Frankhauser* Accessibility, Amenities and Needs - a conceptual framework for exploring households' satisfaction 3. *Julia H. Tabbita* Housing informality in the Buenos Aires Metropolitan Region: A quantitative-spatial assessment for regularization and land use policies 4. *Juste Raimbault; Solene Baffi* Structural Segregation: Assessing the impact of South African Apartheid on Underlying Dynamics of Interactions between Networks and Territories 5. *Eusebio Odiari, Mark Birkin, Susan Grant-Muller and Nick Malleson* The use of big data in spatial micro-simulation of railway passengers
12:00 – 13:00	**Lunch**	

13:00 – 14:30	Keynote 3 - Professor Anne Vernez Moundon
14:30 – 18:00	Field trip
19:00	Buffet Dinner

Monday 11th September

Time	Room 1	Room 2
	Parallel session 7	
09:00 - 10:30	**7A – Demographics** **Chair: Nick Hood** 1. *David Burg* Recurring Patterns in Urban Growth 2. *Francois Bavaud; Theophile Emmanouilidis; Guillaume Guex* Handling social segregation in gravity modelling: a computable scheme 3. *Doignon Yoann* Which spatial convergence of demographic ageing in Mediterranean? 4. *Khneyzer Chadi* Lebanon between analogy and specificity of territorial development processes: The necessary originality of a credible development strategy for the Akkar 5. *Anna Dmowska; Tomasz Stepinski* Evolution of Racial Diversity in Newly Built American Housing Subdivisions	**7B – Big Data** **Chair: Eusebio Odiari** 1. *Tomas Crols; Nicolas Malleson* Quantifying the Ambient Population using Big Data and Agent-Based Modelling 2. *Arnaud Adam; Isabelle Thomas* Revisiting the internal structure of Brussels with mobile phone data: theoretical revolution or data evolution? 3. *Robin Cura* Making large spatio-temporal data analysis easier: Illustrated plea for using (geo)Visual Analytics 4. *Horacio Samaniego; Mauricio Franco; Boris Sotomayor* The Topology of Communicating Across Cities of Increasing Sizes, or the Complex Task of "Reaching Out" in Larger Cities 5. *Marina Toger; Itzhak Benenson; Sarit Weisburd* The deterrence effect revisited: spatial analysis of the impact of police presence on probability of crime.
10:30 - 11:00	**Coffee**	

	Parallel session 8	
11:00 - 12:30	**8A - Politics and Demographics** **Chair: Clementine Cottineau** 1. *Celio Sierra-Paycha* How National Urban Systems shape International Migration Systems: the case of Colombia 2. *Nick Hood; Myles Gould; Jocelyn Evans; Paul Norman* Is your local area susceptible to the radical right? Differentiation UKIP support using an area based classification of electoral wards in England 3. *Myles Gould; Nicholas Hood; Jocelyn Evans; Paul Norman* Introducing an European comparative multilevel study of 'radical right' support 4. *Stephen Clark; Michelle Morris; Nik Lomax* Estimating the UKs referendum on EU membership using e-petition data and machine learning algorithms	**8B - Land use** **Chair: Tomas Crols** 1. *Remi Lemoy; Geoffrey Caruso* Evidence for the Homothetic Scaling of Urban Forms 2. *Alexandre Ornon* A spatial multiscalar modelisation of urbanisation in the South-East of France 3. *Emilie Lerond; Olivier Klein; Jean-Philippe Antoni* Data transformation for land-use / transport interactions exploration 4. *Nikita A. Sinitsyn* Cellular automata for suburbanization modelling: the case of Belgorod
12:30 - 13:30	Lunch	
13:30 - 15:00	**Keynote 4 – Professor Chris Brunsdon**	
15:00	**Depart**	

Abstracts

Keynote Presentations

Sir Alan Wilson
The future of urban modelling

A brief overview of the history of the development of comprehensive urban models is presented and this provides a basis for outlining the present state of the science future research priorities. These are addressed under two main headings: the straightforward but still difficult; and bigger challenges. The first set include data wrangling in the 'big data' era; and being fully comprehensive, adding health and education for instance. These development are illustrated with examples from recent research: a world model, a regional model of the South Pacific, military deployment and piracy. The second set include the challenges of dynamic modelling; the integration of apparently competing modelling perspectives; new maths and new algorithms; and integration with planning and the associated 'wicked problems' agenda.

Paul Longley
Quantitative Geography and the Smart Census

Today, Big Data are enabling thicker empirical descriptions of the form and functioning of many aspects of social systems than ever before. But the achievements of the 'smart cities' discourse are selective, with greatest focus upon the use of sensor webs and other new forms of data to monitor the locations or trajectories of elements of the Internet of Things rather than the circumstances of resident and working populations. Spatial and temporal heterogeneity of outcomes in health, social mobility and social capital formation remain poorly understood and disconnected from theoretical formulations of social justice in the sentient city. The absence of research design in the creation and maintenance of new forms of data creates new scientific and analytical challenges to the inclusivity of truly social science, given that the source and operation of bias in new forms of data is poorly understood. There is a need to address the asymmetry between the sophisticated methods of geographic information science and the quality and reliability of many of the data sources that underpin their usage.

Anne Vernez-Moudon
Built Environment and Health in the Age of Big Data

Evidence is mounting that the built environment of where people live, work and play has an influence on their health. As a result, public health people are reaching out to city and transport planners in an effort to make healthier cities. However, how exposure to the built environment affects health still needs clarification. Past research focused on how the home built environment was associated with health. Yet the residential context is only a small part of daily environment hosting people's activities. There is a need to examine associations between health behaviors and built environment in a precise spatio-temporal framework. This need is beginning to be addressed by rapid advances in sensor technology, which, combined with the ubiquitous use of smartphones loaded with Apps, are now providing not only "big" but also "detailed" data on people's location, mobility and activity patterns. Sensors can also capture environmental (air breathed, ambient noise, etc.) and health-related conditions (physical activity, heart rate, stress, etc.).

Parallel advances in geographic information systems (GIS) bring detailed data on the built and transportation environment. So far, few "big data" researchers have used these data, opting instead to employ "black box" short cuts to characterize both mobility behaviors (e.g., to detect travel modes) and built environment characteristics (e.g., to measure walkability). This presentation reviews practical approaches to attach built environment data to the large numbers of GPS points included in big data. The

aim is to capture spatially continuous, time-based measures of exposure to built environment attributes along multi-day GPS traces. The presentation also introduces ways to model the built environment in GIS in order to streamline environmental data capture along GPS traces.

Chris Brunsdon
Shining a light on NOIR - Rethinking Scales of Measurement

The 'NOIR' referred to here is actually an acronym for the four scales of measurement proposed by Stevens in 1946: Nominal, Ordinal, Interval, and Ratio. Despite being proposed over 70 years ago this categorisation is still influential - and can shape the way people think about choices for data analysis. A number of software packages and text books are structured at least loosely on this framework. However, it has not gone unchallenged and it will be argued here that this approach is at times an unhelpful. There are inconsistencies in recommendations arising from the NOIR categorisation. Also NOIR omits several important scales of measurement. In this talk, I will discuss practical examples of these inconsistencies and omissions, and consider specific cases of omitted scales of measurement focusing on directional data, compositional data and partially ordered sets.

Spatial Interaction Modelling Symposium

1. John Stillwell

Comparing Distance and its Frictional Effect on Internal Migration in Countries Around the World

This presentation examines how internal migration distance and its frictional effect vary between countries. Such comparisons are hampered by differences in the number and configuration of spatial units for which data are available – the modifiable area unit problem (MAUP). One approach is to use flexible aggregation routines to elucidate scale and pattern effects in a set of countries for which finely grained origin-destination matrices are available. A bespoke software platform has been designed, called the IMAGE Studio, in order to perform the spatial aggregation procedures but also to compute a range of internal migration indicators and calibrate a doubly constrained spatial interaction model for each spatial configuration at each scale. Whilst an exponential relationship between mean migration distance and mean area size has been identified, the modelling results show that the frictional effect of distance remains remarkably stable across spatial scale, except where zones have relatively small populations and are poorly connected. This stability allows robust comparisons between countries even though zonal systems differ. Mean migration distances vary widely, being highest in large, low density countries and positively associated with urbanisation, HDI and GDP per capita. This suggests a positive link between development and migration distance, paralleling that between development and migration intensity reported by Bell et al. (2016). Less variation is found in the beta parameter that measures distance decay but there appear to be clear variations between more developed countries, with lower friction in larger, less dense countries undergoing rapid population growth.

2. Frank Southworth
A Look at Freight Demand Modelling in the United States

This presentation overviews the different approaches to estimating and forecasting the demand for freight services in the United States, pointing out the most common in-practice approaches and how recent and on-going research efforts are likely to move this practice towards new, improved, and increasingly involved model applications, making using of a variety of data sources. These developments are discussed in the context of bringing more detail into the freight planning process: by adding industry, commodity, modal, network, behavioural and logistical details to freight activity models at a number of different regional scales. The discussion is centred on the interplay between freight volumes and freight costs. Emerging methods include the introduction of supply-chain considerations into freight activity models, the use of microsimulation techniques, notably in support of behaviourally motivated agent-based freight modelling, and the inclusion of an expanded range of freight cost factors, including delivery time reliability and other inventory related carrying costs. Supporting these efforts are parallel developments in newly available data sources. Driving much of this modelling effort today is the search for policy-relevant and plan-sensitive freight performance measures, at a time when the condition and carrying capacity of the nation's multi-modal freight networks are coming under increased scrutiny.

3. Martin Clarke
Numerical Experiments: exploring the properties of spatial interaction models using real and imaginary data

Spatial interaction models have been in use by both academics and practitioners for over 50 years. In this paper we review the extensive application of these models over this period in Leeds. In particular we describe how the properties of spatial interaction models can be explored by undertaking "numerical experiments" to observe how different model solutions emerge through variations in model parameters. We also describe the extensions to the traditional models that are required to ensure the models perform adequately in a real world commercial context. These include factors such as elastic demand, brand

preference, agglomeration effects, measures of accessibility and so on. Examples will be given from a range of sectors. We finally look in to the possibilities of using these models to address new types of problems in the current environment of "Big Data", where new sources of consumer spatial interaction activity are becoming available.

4. Mark Birkin
A family of spatial interaction modellers

Alan Wilson's 'Family of Spatial Interaction Models' (Environment and Planning A, 1971, 477 citations) is one of the highlights in an outstanding portfolio of original and high impact contributions to the disciplines of geography and regional science. In this paper, I wish to draw attention to the complementary importance of the family of spatial interaction modellers who have done much to consolidate, develop and broaden this impact from one individual to a "School" with even more wide-ranging and continuing influence on Quantitative and Theoretical Geography in Europe and beyond.

Working through a family tree from the 1960s to the present day, we will see how the concept of spatial interaction modelling has been complemented and embellished under the influence of complexity and bifurcation theory, microsimulation, agent-based modelling and latterly data science.

With a particular focus on the range of projects which are still ongoing, the current shape of the portfolio will be described and evaluated in relation to broader fields of academic enquiry. Prospects for continued innovation and further progress will be considered.

5. Michael Batty
Scaling from Spatial Interaction

Spatial interaction models developed over the last 50 years using analogies with classical mechanics, namely through Newton's second law of motion in which the inverse square rule is all supreme. Most of the field that has focused on making these models operational for purpose of predicting movement and only quite recently has there been any reflection on the more substantive concerns as to how scale and geometry are embedded within their structure. But the recent focus in urban theory and modelling on dynamics has thrown to the fore the idea that as cities change, as they get bigger, and as the balance of spatial interactions which ties their components together and enables cities to function changes, then the scale of cities changes qualitatively. This is seen most dramatically in the notion that as cities grow their attributes such as income, poverty, crime and so on change by scaling allometrically. Much of this thinking is tied to biological questions but some is tied to social physics, particularly city and related size distributions. In short, there is now a movement to think more substantively about the properties of cities with respect to scale and to explore the meaning of change through allometry, rank size and other kinds of scaling associated with city size. In this talk, I will sketch how the field is developing, introducing ideas that are by no means complete but which seek to react to ideas about spatial interaction in terms of scale, drawing on various developments in complexity theory and social physics. To an extent, these ideas do set a new agenda for they broach the notion that the systems we are dealing with are never stable, they are continually changing in qualitative terms, and are getting ever more complex.

1A - Environment and Health

1. Sonia Trabelsi; Isabelle Thomas
On measuring "green": a comparative analysis of four databases in Namur (Belgium)

The (further) development of green spaces in urban areas has become a trending topic in the last decade. Studies on hedonic pricing, environmental and ecosystem benefits and human health issues, all consider green (urban) areas from different perspectives.
An interdisciplinary systematic review on the measures of green spaces conducted within the GRESP-

HEALTH research project (Trabelsi et al. 2016) shows that a wide range of datasets and measures are to be found in the literature.

In this work we aim at looking at, and identifying, different typologies of urban, peri-urban and rural areas by means of four different land use databases on the same study area. For this purpose, we look into land use information provided by Corine Land Cover, Urban Atlas, NDVI, and a self-developed database from Google Earth and Google Street Images. The study is conducted on the area of Namur, a city of 100.000 inhabitants in Belgium with urban and rural features.

We use descriptive statistics to compare the information provided by the four databases, and assess the variance and the gap among them. We further compare the data by looking into surface, shape, border and other morphometric characteristics using GIS and Fragstats.

The comparison of the four databases is subject to the choice/definition of a common classification of the land uses, as the data is provided in different formats (i.e. vector, raster; surface, percentage…). Five main classes of land uses are defined: built up, agricultural and pasture, road and rail, water, general green areas. These five classes can have sub-classes according to the detail level of the database.

First results show both a great variation in the percentage of surface identified by each database for some land uses (i.e. built up), but also consistency in surface for some other classes (i.e. agriculture and pasture). The main cause of such variations can be explained by the aggregation level (and therefore low definition) of the patches.

Finer definition of the data allows for analysis of the intertwining of the classes in the study area: how does green interact with the built-up? Which typology of green is located where? Are there roads allowing the access to green spaces? In our work we will look, among other things, how the four databases can help answering these questions.

The four databases have pros and cons: easy access but low image quality; free access and good quality but limited number of areas covered; high precision of data but time consuming process of data creation and low reproducibility.

Outcomes will provide a reflection tool for selecting the most appropriate database according to different study needs.

2. Geoffrey Caruso; Marion Le Texier; Mirjam Schindler
The Green Mismatch Hypothesis: concept framing and empirical views from Brussels, Luxembourg and Rouen.

Urban green space provides multiple ecological services and there is widespread evidence of the social benefits it brings to citizens. Yet knowledge gaps persist in quantifying how and whether the socio-economic benefits of green space accrue to all households within an urban area or only to a portion of them depending on their socio-economic status and residential location. There is empirical literature on the equity of access to green but it is not much harmonised so that conclusions remain contextual. It is also largely a-spatial, considering neighbourhoods as containers with very few attention paid to geographical mechanisms that can lead to inequities in access to green space. This situation leads us to proposing a theoretical framework where geographical mechanisms are explicit and can therefore be tested. We mimic Kain's spatial mismatch hypothesis, which looked at the spatial differentiation between jobs and residences, and propose a 'Green Mismatch Hypothesis', defined as the spatial separation between the provision of public green space and the residential location of those who are the most in needs for them because they cannot compensate with private green space. Several mechanisms are arguably at stake to explain such a discrepancy. There are direct effects such as housing markets and the sorting of households along the urban-suburban gradient or urban infill policies that decrease green space in specific neighbourhoods. There are also more indirect effects, such as parks related housing valuation and gentrification, or the endogeneity of residential choice and the demand for local green space. In order to disentangle these effects empirically, we suggest that data must be gathered along three dimensions: (i) households and their socio-economic characteristics, (ii) centrality to capture standard housing costs-

transport costs trade-offs, and (iii) local/neighbourhood green space provision (exogenous green externality). In this presentation we frame the Green Mismatch Hypothesis, review the empirical literature, and show preliminary comparative results from multinomial logit and quantile regressions applied to a survey conducted in Brussels, Luxembourg and Rouen.

3. *Marlene Boura*
How does the spatial distribution of green within cities impact carbon uptake?

Cities - particularly the denser ones - are often depicted as sustainable systems that reduce the consumption of land and optimize energy use for buildings and transport. Cities, however - exactly because they concentrate human activities - constitute the main source of CO_2 emissions into the atmosphere. Yet it is important from a resilience perspective to assess to what extent cities can themselves cope with their own emissions. We address this issue by examining how the internal spatial organization of cities can impact the flow of carbon between their main sources, i.e. roads and built-up land, and their main storage infrastructure, i.e. urban green space and forests. Is it better to have a dense core with a peripheric green belt? Large green patches within the core center? Or small and fragmented green spaces?

Carbon flows are a kind of spatial interaction between located sources and located destinations, hence emission factors, storage factors and diffusion parameters should interact with distance between carbon emissions origins and carbon sequestration destinations. The objective of the present work is to test whether the internal spatial organization of cities matters for evaluating carbon uptake potentials of cities or whether cities can simply be considered as single objects with a quantity of carbon emissions and carbon sink capacity derived directly from aggregate land use data.

We conduct an analysis at the European scale using the GMES/Copernicus Urban Atlas 2012 database as sole input. The data comprises detailed land use information for 697 European cities (Functional Urban Areas) and an inventory of trees located within artificial land use classes (Street Tree Layer). We construct (and automate) a carbon emission potential map from built-up land, densities and roads, and a carbon sequestration potential map from green land uses and trees. For simplification both constructs rely on homogeneous physical, biological and urban assumptions across cities (e.g. coniferous as representative vegetation, constant traffic per road type,...). Our potentials are not validated against empirical carbon emission/sequestration data because they do not exist consistently for the entire dataset and because our aim is to compare different urban structures and analyze how efficient they are to capture the emitted carbon, independent of spatial heterogeneities in vegetation and environmental conditions across Europe. We then formalize the relationship and flows between sources and sinks as a function of distance, diffusion parameters (especially wind speed) and exogenous geographical variables (latitudes, temperature,...). We intend to reveal which spatial organization exhibits higher resilience to internal emissions and concentrations. Further, we analyze the sensitivity of resulting carbon budgets per city to changing diffusion parameters and distance decay functional forms. This allows us to contrast a fully aggregated view where the relative positions of different land uses (emission and storage) does not matter, a fully disaggregated view with no diffusion where again the relative positions of different land uses does not matter, with all situations in between where the internal organization will matter. Then the budget is the result of variations between fragmentation of green spaces and the diffusion parameters.

4. *Thierry Feuillet; Hadrien Commenges; Mehdi Menai; Helene Charreire; Emmanuelle Kesse-Guyot; Romain Reuillon; Julie-Anne Nazare; Serge Hercberg; Jean-Michel Oppert*
Why do I walk here? Computing a large scale GWR for hierarchising the environmental correlates of walking in France

Background

Walking, as the main component of daily physical activity, contributes to reduce the risk for cardiovascular and other chronic diseases, and to increase well-being (Warburton et al., 2006). Many scholars therefore seek at exploring walking environmental determinants in order to identify potential leverages for favoring a shifting towards healthier and more sustainable behaviors. However, this search for determinant identification still suffers from two major concerns. (i) The bulk of empirical studies does not take into account the consequences of spatial heterogeneity, in both the statistical analyses and their interpretations. This spatial heterogeneity implies that the results of any study of a limited area depend explicitly on the bounds of that area (Goodchild, 2009). (ii) Putative determinants are often taken individually or through interaction terms that are limited to a few pairs of variables, while they should be considered as combinations of factors, free to vary, in terms of hierarchy, by groups of individuals and/or by places.

To address those two concerns simultaneously, we looked at a methodological mean (large scale GWR) allowing spatial contexts to be drawn, and in which the hierarchy of environmental correlates of walking would vary.

Data and method

Individual data regarding walking behaviors and other personal covariates were derived from the Nutrinet-Santé study, an ongoing web-based cohort launched in France in May 2009 (Hercberg et al., 2010). The sample used in this study included 40,374 respondents (mean ± SD age of 48.8 ± 14.4 years). The two outcome variables include walking for errands and leisure (time spent walking during the past 4 weeks, declared by questionnaire). Independent environmental variables include 7 GIS-based built and socioeconomic variables, assessed around each home address respondent.

We (i) performed a large scale (the whole of France) geographically weighted logistic regression (GWR) after splitting the study area and parallelizing algorithms to overcome computational issues (due to the sample size – n~40,000) and (ii) carried out a k-means clustering of the GWR scaled coefficients. Parallel computing was enabled through the Huma-Num Very Large Research Infrastructure, a service provided by the French National Center for Scientific Research in the field of human and social sciences.

Results and conclusions

The GWR coefficient clusters were mapped and revealed spatial contexts in which the hierarchy of environmental correlates of walking varies. Beyond the expected distinction between rural and urban areas, results interestingly suggest that walking correlates vary by cities. More specifically, spatial clusters were associated to the size and the type (e.g., core city, surburban city) of cities. For instance, population density is associated to walking for transportation only in small to medium-sized cities, but not in largest ones. Moreover, a regional scale spatial structure also appears, indicating that similar cities in terms of size and centrality do not encompass the same correlates of walking according to the region. In terms of public health implications, our results suggest that planning policy encouraging walking should be considered locally rather than globally.

1B - Mobility

1. Robin Lovelace
Implementing spatial interaction models: from prototype to globally scalable tools

Origin-destination (OD) data forms the basis of much research, in transport, migration and transport studies. In parallel with the growth in the number and size of such datasets, methods for simulating and updating them have proliferated. Many of these methods are known as spatial interaction models (SIMs). SIMs are thus vital for furthering our understanding of large-scale human movement patterns. However, much of the academic literature focusses on the development of new and sophisticated methods, rather

than the implementation of SIMs on large datasets. This is problematic for practitioners wishing to use SIMs in their work: while there is much information on which SIMs are most flexible or effective theoretically, there are few resources for assessing how scalable different methods are 'on the ground'. Taking a broad definition of scalable, this paper will explore SIMs in terms scalability and computational efficiency. The results will be demonstrated with reference a planned modelling project, which would use globally scalable SIMs with the aim of informing effective sustainable transport policies worldwide.

2. Jean-Pierre Nicolas; Nicolas Pele; Cyrille Francois
Urban Form and Daily Mobility Interactions: an Analysis of Socioeconomic and Environmental Impacts Thanks to LUTI Model Simulations

The spatial organization of cities deeply changed all along the 20th century, but the effects of urban form on daily trips are still under debate (Ewing and Cervero, 2010). However, methods used to appreciate these impacts are not really efficient to separate the different factors: as well as through city comparisons or through diachronic analysis, even thanks to LUTI modelling, it is difficult to separate urban form impacts from economical or cultural contexts or general changes (Echenique et al., 2012). In addition, the tools to assess urban planning and transport policies are often focused on one dimension of sustainable development, with restricted economic or environmental approaches, and rarely take the social dimension into account. Last, the results are provided at an aggregated level, without differentiation between household types (depending on their location, level of income, etc.)

The main purpose of that presentation is to propose a simulation exercise carried out from a real city case and testing the impacts of differentiated tendencies of urban form, all other things being equal. These results will be provided for the 3 pillars of sustainable development and distinguished by type of households, both for the household expenditures (Pelé et Nicolas, 2016) and for the environmental impacts of transport (François et al., 2017).

The SIMBAD LUTI model, calibrated on the Lyon urban area (France) by the LAET (Nicolas et al., 2013), has been used to simulate different urban form trends and to assess their social, economic and environmental impacts. More precisely, the results are based on the construction of 3 urban form scenarios inspired from the VILMODes project (collaboration between THEMA, LVMT and LAET laboratories, supported by the French PREDIT program – Antoni et al., 2015):

_ A scenario of a polycentric urban area, with sub-hubs distributed along a tram-train network, consistent with the Transit Oriented Development principals (Calthorpe, 1993);

_ A scenario of a sprawled urban area, with a stronger proportion of people located in the remote parts of the center;

_ A scenario of a monocentric urban area, compacted around a dense city center.

Antoni, Bonin, Frankhauser, Houot, Nicolas, Thierry, Tomasoni, Toilier, Vuidel, 2015. VILMoDes - Ville et mobilités durables.

Calthorpe, 1993. The Next American Metropolis: Ecology, Community, and the American Dream. Princeton Architectural Press, New York.

Echenique, Hargreaves, Mitchell, Namdeo, 2012, "Growing cities sustainably - does urban form really matter?". Journal of the American Planning Association, 72(2), pp.121-137.

François, Gondran, Nicolas, Parsons, 2017, "Environmental assessment of urban mobility –a method based on life cycle assessment of the results of a LUTI model". Ecological Indicators, 72, pp. 597–604.

Ewing,Cervero,2010. Travel and the Built Environment: A Meta-Analysis. J. Am. Plann. Assoc. 76, 265–294.

Nicolas, Bonnel, Bouzouina, Cabrera, Pascal, Pluvinet, Toilier, Zuccarello, 2013. La prospective urbanisme-transport avec la plateforme SIMBAD. LAET report.

Pelé, Nicolas, 2016, « L'impact du lieu de résidence sur la mobilité quotidienne des périurbains : une

approche par la modélisation de leurs dépenses». Colloque ASRDLF, 7-9 juillet 2016, Gatineau, Canada. 11 p.

3. Nick Malleson; Susan Grant-Muller; Frances Hodgson; Gillian Harrison
Quantifying Personal Pollution Impacts to Inform Transport Scheme Innovation through New Generation Mobility Data

An improved understanding of the spatial and social distribution of the health impacts that arise from the introduction of new travel initiatives will support more targeted and efficient policy development. Furthermore, once the health benefits associated with certain schemes have been reliably quantified, policy makers may find it easier to introduce policies that might otherwise prove unpopular with citizens (e.g. road pricing, car parking charges, etc.). To this end, the recently-funded HABITS research project will interface new generation 'Track and Trace' information on individual citizens' location and mode choices (detected as mobile phone app-based sensor data) in collaboration with Newcastle City Council, in the UK, to assess the efficacy of existing transport policies and to support the design of new policies.

A prime example of where such research will have value is in the quantification of the disease burden associated with outdoor air pollution. In the UK, exposure to outdoor air pollution is estimated to contribute to approximately 40,000 deaths each year [1]. There is a growing body of evidence that traditional exposure estimates that only consider residential populations and disregard mobility are significantly underestimating real exposures to ambient pollution [2-4]; to the extent that the Health Effects Institute recommend models that account for personal exposure or include time-activity data can produce the "best" estimates of human exposure [5]. This paper will present the preliminary results from ongoing HABITS work that addresses the following research question: "can high-resolution location and activity data, coupled with reliable models of air quality, be used to more accurately quantify the true exposure of individuals to air pollution and derive robust spatio-temporally explicit policies to reduce this disease burden."

Specifically, the paper will present a preliminary risk model, highlighting the times and places where high levels of pollution intersect the largest ambient populations. This new knowledge will contribute to the process of collaboratively deriving robust new policies to reduce exposure where it is most acute.

References
[1] Royal College of Physicians (2016). Every breath we take: the lifelong impact of air pollution. London: Royal College of Physicians.
[2] Dhondt, S., C. Beckx, B. Degraeuwe, W. Lefebvre, B. Kochan, T. Bellemans, L. Int Panis, C. Macharis, and K. Putman (2012). Integration of population mobility in the evaluation of air quality measures on local and regional scales. Atmospheric Environment 59, 67–74.
[3] de Nazelle, A., E. Seto, D. Donaire-Gonzalez, M. Mendez, J. Matamala, M. J. Nieuwenhuijsen, and M. Jerrett (2013, May). Improving estimates of air pollution exposure through ubiquitous sensing technologies. Environmental Pollution 176, 92–99.
[4] Smith, J. D., C. Mitsakou, N. Kitwiroon, B. M. Barratt, H. A. Walton, J. G. Taylor, H. R. Anderson, F. J. Kelly, and S. D. Beevers (2016). London Hybrid Exposure Model: Improving Human Exposure Estimates to NO2 and PM2.5 in an Urban Setting. Environmental Science & Technology 50(21), 11760–11768.
[5] Health Effects Institute, 2010. Traffic-related air pollution: a critical review of the literature on emissions, exposure, and health effects. Special Reports. Health Effects Institute, Boston, MA.

4. Larissa Silva Lopes; Benjamin Motte-Baumvol; Thomas Thevenin

Urban mobility and the spatial distribution of economic activities in Rio de Janeiro

In developing countries such as Brazil, the economic growth is gradually improving the population's standard of living, resulting in major impacts on urban mobility, particularly with regard to motor vehicle access. Between 2001 and 2012, the total growth of the car fleet in Brazil was around 3.5 million (Rodrigues, 2013), with 5.4% of this growth only in the Metropolitan Area of Rio de Janeiro. Presently, the city is experiencing severe congestion episodes (Beyer, 2012), due to saturation of the main roads, and a fragmented and inefficient public transport system.

For a country in economic development in the 21st century, it is very important to plan and monitor the evolution of urban mobility in order to make it efficient to its users and in accordance with the goals of sustainable development. In this context, land use transport interaction (LUTI) models can be important tools in understanding how the transport systems affect land occupation, which may explain the spatial distribution of economic activities—and the traffic they generate—in the territory.

Since 2006, the French research laboratory ThéMA has been developing one of these models, an agent-based LUTI simulation platform called MobiSim, dedicated to understand the relationship between urban sprawl and transport networks. One of its applications is taking place in Rio de Janeiro, and consists in the simulation of possible evolution scenarios of the urban growth and the transport system in its Metropolitan Area until 2050.

This paper will present the first phase of the project: a diagnosis of the urban mobility and the spatial distribution of economic activities in Rio de Janeiro. We aim to jointly analyze three important variables of urban mobility in the region: the access to transport, through the rate of motorization and the availability of public transportation; the location (concentration or dispersion) of these activities; and the socio-spatial segregation, strongly present in the city.

By modelling and analyzing the spatial distribution of households and economic activities, along with the transport lines, we intend to better understand the mobility generator zones and the areas of precarious accessibility. For this diagnosis, over 4 million households and 380,000 economic activities were georeferenced from the National Registry of Addresses of IBGE (Brazilian Institute of Geography and Statistics), allowing the analysis of the land use in a very detailed scale, something unprecedented in Brazil. It is expected a direct link between areas of precarious accessibility and the municipalities that presented the greatest increase in motorization in the past years, and a strong concentration of the mobility generators – especially formal employments - in the historical center and richest parts of Rio de Janeiro.

In a city marked by strong socio-spatial segregation like Rio (Silva, 2012), the lack of access to transport can be an important form of social exclusion (Lucas, 2012). Therefore, we expect this project to be an important scientific support for the local urban transportation actors, indirectly contributing to reducing vulnerability caused by uncontrolled urbanization and to a more sustainable development of urban mobility in the region.

2A - Health and Lifestyle

1.   Paul Williamson; Xin Gu; Karyn Morrissey; Ferran Espuny-Pujol
Small-area estimation of comorbidity: an indirect survey calibration approach

With an ageing population, the prevalence of patients with multiple health issues (co-morbidity) is increasing. Patients with comorbidity are more complex to treat, placing additional pressures on local health services. Understanding the spatial distribution of such papers provides a first step to ensure more appropriate distribution of resources and provision of services. Knowledge of the underlying prevalence of comorbidity would also allow identification of patterns of under/over-diagnosis and service uptake. However, at present, information on comorbidity is confined only to those that self-present and are doctor-diagnosed. The aim of this paper, therefore, is to estimate the spatial distribution of patients with comorbidity at the local level (UK Lower Super Output Areas). The approach taken is to calibrate existing

data from an existing health survey of the private household population to fit known local population attributes, such as age, sex and socio-economic status. The results presented here are novel in (a) validating the resulting estimates against the closest comparable measures of health available from health admin data; and (b) quantifying the uncertainty associated with these estimates.

2. Emma Wilkins; Michelle Morris; Duncan Radley; Claire Griffiths
Geographic variation in the validity of two sources of secondary food environment data

Background: Secondary data (i.e. data created for purposes other than research) on the locations of food outlets is increasingly used by both researchers and policymakers e.g. to examine geographic disparities in food environments, to identify areas where access to healthy food is limited, and to explore links between food environments and health outcomes such as diet and obesity. However, evidence for the validity of UK-specific data is limited, with little known about potential geographic biases. This study therefore examined variation in the validity of two UK sources of secondary food environment data (SFED): Ordnance Survey Points of Interest (POI) data and food hygiene data from the Food Standards Agency (FSA), across different environment types, with street audits used as the 'gold standard'.

Methods: Audits were conducted across 54 Lower Super Output Areas (LSOA) in England, covering six environment types (characterised by rural/urban classification, and three levels of deprivation). All streets within each LSOA were covered to identify all food outlets therein. Audit-identified outlets were matched to outlets in the SFED to identify true positives (TP: outlets in both the SFED and the audits), false positives (FP: outlets in the SFED only) and false negatives (FN: outlets in the audits only). Agreement was assessed using positive predictive values (PPV: TP/(TP+FP)) and sensitivities (TP/(TP+FN)). PPVs reflect the prevalence of erroneous entries within the SFED; whereas, sensitivities reflect the prevalence of missing data. Both statistics vary between 0 and 1, with higher values indicating better agreement. Variation in PPVs and sensitivities across environment types was assessed using Chi-squared tests.

Results: For POI data, PPVs were statistically significantly higher in rural (0.85, CI: 0.81 - 0.89) than in urban environments (0.76, CI: 0.73 - 0.79, $p < 0.001$). There was also a trend for PPV to decrease with increasing deprivation, although this was not statistically significant. Sensitivity was not associated with environment type. For the FSA data, neither PPVs nor sensitivities were associated with any environment type.

Conclusion: There is no evidence of geographic bias in FSA data, providing confidence in using tools and research based on these data. Conversely, geographic bias appears to be present in POI data, with PPVs higher in rural than in deprived areas. This means POI data has a higher prevalence of erroneous entries in urban areas compared to rural areas, which may reflect a higher turn-over of food outlets in urban areas. Densities of food outlets tend to be higher in urban than in rural areas, and the bias within the POI data tends to amplify this disparity. For example, the POI data suggested that the ratio of outlets in urban areas to rural areas was 2.0, whereas the audits indicated a ratio of only 1.7. Such bias could lead to confounding if not appropriately controlled for. The above notwithstanding, considering POI has advantages over other SFED (e.g. more detailed outlet classifications and better spatial accuracy), POI is still a useful and recommended source of data, provided this geographic bias is considered and appropriately controlled for.

3. Elena Guk
Modelling of the territorial tourist and recreational system of Norilsk Region

In early 20th century, many areas of traditional land use in the Arctic were turned into new industrial areas. One of the largest mining plants in Soviet Union, built above 69°N, caused emergence of Norilsk, and now it's the second most populated city above the Northern Circle, estimated as one of the most polluted settlements in the world. Remoteness of the newly built area in combination with hazardous climate and industry triggered emergence and development of local recreational practice. Tourism and recreation are

studied there in a combination because of their high interconnectivity in the region: most tourists in the system are Norilsk residents whose main purpose of travel – within the region or out of it – is to recover and improve their health.

The first-stage purpose of research was to reveal peculiarities of recreation development in Norilsk Region, which is defined in this case as area of accessibility by local transport from Norilsk. The research has showed that this region includes neighborhoods of Norilsk, seaport town Dudinka and lakes of western Putorana Plateau (roughly 100-200 km from the city), and that dozens of recreational camps had been built there since 1940s. The fieldwork, done in 2013, has resulted in identifying different forms of outdoor recreational activities and facilities in the region. It has been concluded that in changing economic and social conditions local tourism and recreation has showed its resilience: it remains an essential part of everyday life and determinant of well-being of region inhabitants, not only due to its necessity for healthcare in ecological conditions but also because of underdevelopment of other services, including public transportation (both interregional and local), and ways of spending free time. Thus, tourism and recreation plays important role in sustainability of Norilsk Region as an activity that helps to balance economic priorities of Norilsk Nickel, ecological needs (area is almost not damaged by recreational activities) and human needs to recover.

The second stage of the research is to reveal the principles how the tourist and recreation system in Norilsk Region is built. The research showed that it consists of such elements as customers (locals and incoming tourists), tourist attractions (natural and human-made sights, National Reserve, museums etc), tourism infrastructure (accommodation, transport), subsiding organizations (Norilsk Nickel) and government. As long as tourist and recreation system in the region significantly depends on economic and legal issues, the system is highly interconnected with overall structure of regional economy, healthcare system, well-being and efficiency of human resources and thus sustainability of economy and community. The hypothesis of the research is that using methods of modelling in geography, with model testing on another regions, can show the most efficient and/or sustainable model of tourism and recreation system in Norilsk Region, which probably can be used for another regions.

4. Nik Lomax; Michelle Morris
Assessing activity levels of individuals in a large, self-selecting dataset

This paper presents findings on the physical activity levels of ~500,000 individuals who are registered to use Bounts, a lifestyle and fitness app which launched in 2013. Bounts allows users to connect other fitness apps and wearable devices developed by third parties (e.g. Fitbit trackers), as well as offering its own smart phone app which can be used to track steps and check-in at numerous locations where exercise and fitness activities can be undertaken (e.g. gyms and climbing walls). The technology incentivises users to undertake physical activity, as they are awarded points which can be exchanged for discounts, offers or the opportunity to join various challenges. These data provide insight in to the level and type of physical activity, engagement with technology and spatial mobility patterns of a large group of individuals over a 12 month time period.

Physical activity is a leading risk factor for a variety of non-communicable diseases such as diabetes, cardiovascular disease and cancer (World Health Organisation, 2015). Globally 1 in 4 adults are not active enough. Insufficient physical activity contributes directly to overweight and obesity which are recognised as a global epidemic (Caballero, 2007), contributed to by obesogenic environments (Lake and Townshend, 2006) and increasingly sedentary lifestyles (Jebb and Moore, 1999). Latest estimates put the net-cost of healthcare and welfare for overweight and obese people in the UK at £2.47 billion per annum (Tovey, 2017). Part of the solution for tackling the obesity problem is through technological interventions (Bacigalupo et al., 2013). This paper adds to this debate by presenting findings from an ongoing scheme which incentivises people who sign up to become more active. In order to do this, it allows users to engage with the scheme using a wide range of technologies, from wearable trackers to smartphone apps. We present the demographic profile of these users, investigate differences between groups, over time and

across geographies. We present some insights in to how schemes such as Bounts, in which users self-select and are incentivised to be physically active, might help increase fitness levels in some groups. Key findings include corroboration with existing literature about the gender balance of uptake for health and wellbeing technology and the number of steps taken on a daily basis. There are clear seasonal patterns in the level of activity individuals undertake and notable changes in the number of users as marketing interventions are introduced. There is a positive relationship between age and average steps taken per day, contrary to findings reported in previous studies.

5. Rachel Oldroyd; Mark Birkin; Michelle Morris
The use of non-traditional data for monitoring foodborne illness: methodological recommendations and considerations

The Food Standards Agency (FSA) estimate that 1.7 million cases of foodborne illness are contracted each year in the UK, of which 22,000 cases result in hospitalisation and 700 result in fatality (Tam et al., 2014). The burden of foodborne illness on the population and economy remains unacceptably high and there are several problems associated with the way traditional data is used to monitor the problem. As many victims of food poisoning neither report their illness nor visit their GP, national surveillance data severely underestimate the incidence of foodborne illness. GP data publication takes approximately two weeks following an appointment. Subsequently the data is unsuitable for the timely identification of harmful pathogens (Achrekar et al., 2012).

In recent years, Twitter has emerged as a useful source of information for monitoring and mapping both disease and public health outbreaks. Available in near real time, Twitter data can be attributed to a specific location and can include a wealth of information not available in traditional data. Studies have ranged from mapping influenza outbreaks (Culotta, 2010) to monitoring dental pain (Heaivilin et al., 2011), however studies focusing on foodborne illness are limited.

This study used systematic scoping methods to retrieve and analyse all primary research concerned with monitoring public health and disease outbreaks using non-traditional data such as Twitter and restaurant reviews. Emerging from this study were methodological recommendations for using non-traditional data to calculate the incidence of a public health ailment or disease. This paper will discuss these recommendations, and consider the use of non-traditional data to more accurately quantify the incidence of disease and to further inform food establishment inspection procedures in the UK.

2B - Spatial analysis: Applications

1. Nir Fulman; Itzhak Benenson
Why Do We Search for Parking for So Long?

The reason why parking search in the city center is too often a disaster is evident - demand for parking there is always higher than the supply. Analytical models predict low average cruising time up to a very high, ca. 98%, average parking occupation rate, while in simulations cruising time is high starting from ca. 90% occupation (Levy, Benenson, 2013). We claim that simulations better reflect the reality and demonstrate that long parking search is caused by inevitable spatial heterogeneity of parking demand and supply that is missed in analytical models, and present a new analytical model of curb parking search which outcomes are fully compatible with the simulation results.

Our analytical model of parking search considers groups of drivers that search for parking τ = 0, 1, 2, ... time

units, τ≤τmax, in a "grid city", and describes dynamics of the numbers of cruising cars, occupied parking spots and cars that searched for longer than τmax. Our simulation model considers a grid city with a ratio of 1:80 between the number of buildings and parking spots. To reflect overall demand (T) to supply (P) ratio T/P = q < 1 we assume that each building generates 80*q parking demand.

We assume that the demand for parking is essentially non-uniform and, given q, the demand for a fraction s of buildings is (q + α)*80, where q + α > 1. Interesting cases are those of high q, as q > 0.9, and essential fraction of buildings with high demand, i.e., s ~ 0.5. The dynamics of parking are studied for different drivers' parking search tactics, such as constant search route around the destination, or random walk biased toward the destination.

With both analytical and simulation models we demonstrate that, irrespective of the search tactics, parking search time is defined by the values of s and α that reflect heterogeneity of demand. For sufficiently high s and α even for a random allocation of buildings, those of high demand form one or more large clusters. Within and around these clusters, the number of cars that arrive and search for parking is essentially higher than the number of parking spots that are vacated during τmax. For example, for q = 0.95, α = 0.2 and s = 0.5, ca. 12.5% of the drivers whose destinations are within clusters of high demand cruise for longer than 10 minutes. At the level of the entire city this results in 5% of the drivers cruising for τmax and longer, despite close to zero search time in case the destination building is located beyond a large cluster of buildings with high parking demand.

We apply our model to the Israeli city of Bat Yam and show that despite a low, ca. 70%, average demand to supply ratio, spatial heterogeneity of the demand and supply cause essential fraction of drivers to search for parking for 5 or more minutes. We then discuss parking policies that could reduce cruising for curb parking in the city.

2. *Yonatan Shaham; Itzhak Benenson*
Modeling City-Scale Fire Spread in Mediterranean and Middle Eastern Cities

Fires are a major risk to life and property. Firefighting services are established to cope with routine of 3-5 structural fires per day per million citizens. However, in a case of several simultaneous fires, firefighters' capacity is insufficient. Multiple Ignitions (MIs) can be caused by severe wild fires, industrial catastrophes, earthquakes, or during war and rocket launching. MIs pose great threat to cities and the only choice is to prioritize firefighters' reaction and delay or even not respond to fires of lower potential damage. New strategies and policies of MIs management should be sought to establish these priorities. These strategies and policies cannot be assessed by simple extrapolation, since spatio-temporal dynamics of MIs and the lack of firefighters should be accounted for. We thus need high-resolution spatially-explicit model of fire spread in cities.

Existing city-scale fire spread models were developed for USA and Japan where the majority of constructions are flammable. Our study presents a model of for Mediterranean and Middle Eastern (MME) cities, where almost all constructions are non-flammable and fire spread between buildings is defined primarily by the man-planted flammable vegetation between constructions. The MME model accounts for the internal 3D structure and ventilation scheme of every building. In case building's plan is unavailable, we establish it anew, applying a novel algorithm for partitioning buildings' footprints into apartments and rooms. Outdoor fire spread is defined in the model by the atmospheric conditions and spatial pattern and type of vegetation.

The model reveals that, unlike USA and Japan, fire spread in MME cities is highly sensitive to spatial pattern of vegetation near the buildings. Implementing the model in Haifa, Israel, we found that ignition of vegetation is responsible for over 60% of the building-to-building fire spread events, while the rest were due to combination of vegetation ignition and fire brands. No building was ignited by radiation from other buildings. This is different from the results obtained in the similar model study in the USA, where vegetation is responsible for 30% of building-to-buildings fire spread cases, while the rest 70% are caused by direct contact and radiation. We further demonstrate that proper management of urban vegetation in

Haifa can preserve its coverage while reducing fire spread there by almost 90%.

The goal of the current model is to construct the maps of risks and expected damages. The risk maps represent the probability that, given weather conditions, a fire that started in a certain building will spread to the buildings around. The (dynamic) maps of damage represent the expected fire area t minutes after the fire starts and is not managed. Both series of maps serve firefighters for estimating the urgency of reaction to the fire, depending on its location in the city, during MI scenarios.

Our next step is to extend the model towards spatially-explicit agent-based model that includes firefighter agents and their response to the fire dynamics. The model will be used as a Serious-Game environment for training firefighters in scenarios of MIs caused by the wildfires and earthquakes.

3. *Maxime Colomb; Mickael Brasebin; Julien Perret; Tannier Cecile*
Simulation of a realistic residential development with the integration of two existing models

In a global context of urban sprawl and increasing housing costs, policies for residential development are an important aspect of urban and regional planning. There are two major planning concerns: firstly, to ensure that housing supply meets housing demand both quantitatively and qualitatively, and secondly, to reduce the negative environmental impacts that may result from residential development, especially an increase in the length and the number of trips by car and the fragmentation of natural and agricultural areas. In France, several planning documents exist that aim to control residential development. Regional planning policies are contained in the Schéma de Cohérence Territorial (Territorial coherence framework) or SCoT, and the PLH (Local Housing Plan). In addition, each local authority has its own local urban masterplan (in French, Plan Local d'Urbanisme - PLU). The PLU defines places where residential developments can occur and also specifies the design parameters of allowable buildings on the site, such as building height, orientation to existing context, and building location within the parcel. A problem arises while applying the recommendations and the zonings contained in each of these documents. The form and location of residential developments as defined in these planning documents will often contradict one another.

In this paper, we present a spatial simulation platform to support the integration of regional and local planning policies that aim to control residential development. This simulation platform integrates two models: MUP-City and SimPLU. MUP-City simulates scenarios of residential development for an entire urban region given a set of planning rules. The first rule ensures that the pattern of cells worth urbanising is fractal. The other planning rules take account of the proximity of roads, accessibility of shops and services, accessibility to public transport, proximity of open spaces, and the presence of areas that cannot be built on. The identification of cells worth urbanising takes the form of a raster map of potential building cells, each characterised by the worth of urbanising them. How worthwhile it is for a cell to be urbanised ranges from zero to one. SimPLU simulates the potential building possibilities in a cluster of houses by generating 3D building configurations that respects the constraints of the PLU. Those potential buildings maximize functions, for example floor surface and are inserted into static parcels. Coupling MUP-City and SimPLU implies several methodological challenges. We are focusing on how to select one regional spatial configuration of residential development among all configurations that can be simulated with MUP-City, with the intent of using this data as input for a simulation with SimPLU.

We test the application of the simulation platform on the urban region of Besançon, known as Greater Besançon, in eastern France. This urban region includes a core city (117,000 inhabitants) and peri-urban residential areas with low population densities spread across fifty-eight small local authorities. The simulation platform was used in this context to explore the possible outcomes of spatial planning policies, set by both the Greater Besançon authority and each local municipality, on residential development over a twenty year period.

4. Milana Glebova

Structural and spatial change in electrical industry of the UK in the beginning of 21 century

The UK power industry has changed considerably since the end of the 20th century. This paper considers the power supply reliability increase through energy resource diversification and promoting local energy sources (including renewable ones) which is not easy for an island country with few grid links to neighboring countries. We consider the impact of the power industry geographic redistribution and the industry reform policies, that the UK had established prior to the subject became the mainstream in continental Europe. The experience gained has been applied to subsequent EU reforms.

We will specifically consider the UK cross-border power transmission and electricity trade. Such a trade is extremely important for the of the largest electricity importers in Europe.

Statistical analysis and power distribution maps have enabled to come to an interim conclusion:

First, the UK (mostly England and Wales) is a success story of the industry's market reforms. The consumer price drop was short-lived, however, the introduction of competition in the power industry and establishing a marketplace for electricity was a prompt and successful move.

Second, the power generation structure by source has changed considerably: besides unequivocal rejection of coal, large -scale introduction of wind and other renewable sources, the country has also reduced the amount of imported gas used for power generation (since 2000, it has been cut by half).

Third, despite some attempts to ensure energy independence, there is no real opportunity to become self-dependent in the future: the country is one of the largest electricity importers in Europe, and its supplies from France (mostly) cover the power shortage.

Fourth, the power generation structure changes directly affect its geography: Shutting down (or conversing to biofuel) the coal-fired power plants will damage the entire historical belt of coal generation facilities in the Midlands.

Fifth, despite the problems with electric power self-dependence and high environmental safety standards, the UK keeps household electricity price at Europe's average; the price has even slightly decreased since 2015. Besides, the price includes a large share of taxes and levies which are usually a burden for consumers in the countries with extensive alternative power sources; still, the generation cost (and the fuel cost) is naturally high: the country lacks a lot of local and cheap energy sources.

5. Hadrien Fouillade Orsini

Crimes location within spatial patterns insuing by motorized network in Marseille (Southern France)

During the 1920's Marseille was called the "French Chicago" due to the presence of an active disreputable background. Illegal activities were mainly localized within central neighbourhoods named as "Le Panier" and "L'Opera" both contiguous to the ports (Montel, 2014). Seeing that the importance of drugs trafficking participates into the bad reputation of the city, Marseille is considered as the most criminal city in France (Peraldi et al., 2015). Marseille is often described as a city divided into two parts : A north – concentrating a poor population, with social issues related to poverty and drugs trafficking, and a south where a wealthy householders are supposed to gather together. Public authority policy has defined several "sensitive urban zones" replaced in 2014 by new "priority districts". Those areas have been delimited by the legislator according to the concentration of poverty using a 200 metres side length grid reference. Such districts include neighbourhoods where majority of residential population has financial resources inferior than 60% of the french average income. French inner city policy is particularly focused in these areas. In Marseille there are 35 "priority districts" covering 35 square kilometres where lives 28% of the global city population.

"Settlements of scores" between the criminal groups has been used to identify criminogenic spaces. Such crimes are relatively uncommon – about 15 facts a year – to justify a complete media coverage. Nevertheless they are enough frequent to enable the distinction of relevant crime hotspots. The location of total "settlements" committed from January 2010 to January 2016 and classified by the police of the

department shows their concentration in reduced parts inside the municipality's boundaries.the illicit narcotics market relates all of these murders within the metropolis. The main locations are housing estates, mostly build in the northern arrondissements. However, not all housing complexes were affected by crime.

The purpose of this research is to explain the interaction between crime spatial patterns with accessibility and urban structure by using a network-oriented approach. When analysing network structure we can define an urban hierarchy distinguishing integrated areas and their outskirts. Free toolboxes such as Spatial Design Network Analysis and Urban network Analysis available in Quantumgis or in Arcgis are used to measure road network indexes. Mathematical network analysis is carried out at different metrics and angular intervals in order to understand the relation between spatial patterns and crimes location in Marseille (Hillier, 2004). Literature exposes, in other spatial contexts, a typology of urban patterns and types of crime (Alford, 1996), the aim of this study is to explain the location of the murders by physical characteristics of the built environment.

REFERENCES
ALFORD Valery (1996), "Crime and Space in the Inner City", Urban Design. Studies, nr. 2, 45-76.
HILLIER Bill (2004), Can streets be made safe? Urban Design International, Vol. 9, Issue 1, pp 31-45.
MONTEL Laurence (2014), "Marseille Chicago": naissance d'une représentation, Faire Savoirs, n°11, 2014
PERALDI Michel, DUPORT Claire, SAMSON Michel (2015), Sociologie de Marseille, Paris, La Découverte, coll. "Repères sociologiques", 124 p.

Special Session – Big Data and Obesity

1. Michelle Morris, Mark Birkin
What is the ESRC Strategic Network for Obesity?

Overweight and obesity persist in the UK, and worldwide, placing both personal and economic strain on society. The strong association of excess weight with other chronic conditions such as type 2 diabetes and cardiovascular disease further increase this burden.

The emergence of new forms of 'big data' provide novel opportunities to understand ways in which the environment promotes or discourages behaviours associated with obesity. Such data include: the number of gym memberships in an area; proximity to green space; consumer behaviour trends for food purchases; GPS track data from mobile phones or physical activity apps; and many more.

The ESRC Strategic Network for Obesity brings together experts from all over the UK, and beyond, from a range of disciplines in academia, retail, local government and charities to explore and generate ideas to make best use of the wealth of data to inform positive change.

The focus of the network is towards understanding elements of the environment which both promote and discourage the likelihood of becoming overweight or obese with view to positively improve these for a healthier future.

This talk will provide an overview of the network activities to date.

2. Duncan Radley; Kate Timmins; Mark Green; Jamie Pearce
Can 'big data' contribute where traditional research falls short? A review of big data usage in obesity research

Facilitated by advances in computing hardware, software and networking, 'big data' have been heralded as a powerful new resource that can provide novel insights into obesity. There is no single agreed definition of big data, but it is widely accepted that greater volume, complexity, coverage and speed of availability are critical components. Often, these data are drawn from non-traditional sources, which are not originally intended for academic research. Despite the growing interest and hype surrounding these new forms of data, there has been no attempt to synthesise evidence of their use in obesity research. The aim of this

paper is to review the contribution of these forms of data to obesity research to date, and consider the implications for the future of 'big data' in this field.

A narrative review was conducted to identify and collate peer-reviewed research studies in which 'big data' were adopted to investigate obesity-related outcomes. Database searches conducted between January and April 2017 found original studies using a variety of data types and sources. These included: social media; transport data; geospatial data; point-of-purchase sales; and commercial data. A narrative synthesis identified three significant ways in which these new forms of data can contribute over and above 'traditional' data: firstly, in moving beyond constraints in scope (in terms of coverage, size, and time); secondly, in providing objective, quantitative measures where traditional research has had to rely on self-reported data; and lastly in its potential for evaluating real-world interventions. However, several issues were found including: data quality; inference and interpretation; data processing, management and linkage; and ethical questions around access to and ownership of data. There was a predominance of descriptive studies, rather than causal or explanatory research, limiting the quality of research findings. It is clear that despite some initial progress and promise in working with big data, the impact on research and practice in obesity has so far been limited.

3. *Emma Wilkins; Mark Birkin; Claire Griffiths; Michelle Morris*
Can big data solve a big problem: the obesity data landscape?

Objective
The basic drivers of obesity are simple (more energy consumed than expended). However, the aetiology is complex. The Foresight Obesity Systems Map depicts over 100 inter-related factors that operate on multiple levels and domains including individual, societal and environmental factors. Policymakers are now advocating for 'whole systems' approaches to obesity, targeting the whole obesogenic system rather than isolated drivers. However, key to such approaches is understanding how the system interacts. Such data are inherently difficult to collect, especially on a large scale. With almost 10 years since the publication of the Foresight Report, most research still fails to consider the interplay between factors spanning multiple domains on a national scale. However, new and alternative 'big data' sources can be used to fill this research gap. The objectives of this paper are to develop a framework in which to effectively report big data for use in a whole systems obesity lens, to use the new framework to report indicative data examples in line with the Foresight domain areas and discuss key challenges associated with using alternative 'big data' sources.

Methods
Synthesis of expert opinion, collated from a series of national workshops funded within the ESRC Strategic Network for obesity, culminated in the development of a reporting framework 'BEE-COAST' for reporting the features of a new large datasets.

Results
Seven exemplary types of 'big data' were included in this review as providing valuable data for 'Whole Systems' obesity research: (i) Ordnance Survey Points of Interest data; (ii) Food Standards Agency food hygiene data; (iii) supermarket loyalty card data; (iv) physical activity applications/wearables; (v) new technologies to record diet; (vi) Acxiom data; and (vii) Call Credit data. The features of these datasets were summarised in accordance with the BEE-COAST Reporting Framework.

Conclusions
Public health and academic decision making is vulnerable to the limitations of the available evidence. Reductionist ideology has led to policy and practice often targeting individualised and isolated causes of

obesity. However, there is a wealth of existing and emerging big data that can be used to help understand the mechanisms driving obesity from a whole systems perspective.

4. Thomas Burgoine: Pablo Monsivais
Development of data-driven tools for policy makers: The Food environment assessment tool (Feat) as a case study

Data-driven tools are becoming an established way to drive discovery and development of theory and hypotheses among researchers. These tools also present an opportunity for knowledge translation with policy audiences, who are increasingly using data and evidence to inform policy. As web technologies have matured, more examples of data-driven tools have been published online. These tools can take different forms, from simply providing information on current conditions ('what is') to tools that can quantitatively model counterfactual ('what if') scenarios. Data-driven tools can help public health professionals understand the geographic and sociodemographic distribution of risk factors and quantify social and environmental conditions that are recognised upstream determants of health.

However, there are few available tools that focus on aspects of the built environment that shape behavioural risk generally, and dietary intake in particular. Network researchers have recently developed an interactive data-driven tool for policy related to the food environment: the Food environment assessment tool (Feat). Feat was developed to address a need for public health agencies to measure and monitor the local food environment. This talk will focus on the development of Feat, as a case study: from basic science, to realisation of need, to alpha development, testing, and feedback, to beta development, launch of a minimum viable product with publicity strategy, to our intended stakeholder engagement and impact evaluation plans, exploration and acquisition of further funding. Challenges included the need for technical and web expertise, feedback integration and 'mission creep', identification of funding sources (seed and ongoing) and appropriate funding models, need for further maintenance and development, and provision of training and user support.

We draw parallels and contrasts between Feat and the Propensity to Cycle Tool (PCT), which was also developed by Network researchers. Finally we attempt to derive some general lessons that may apply to challenges associated with the creation, dissemination and sustaining of data-driven tools for policy. We contend that despite a number of challenges, such tools promise a level of connection between researchers and a range of audiences that is arguably deeper, broader and arguably that better meets our obligations as publicly funded researchers than could be achieved by most other means of knowledge translation.

3A - Geography and economics 1

1. Mehdi Bida; Celine Rozenblat; Elfie Swerts
Modeling hierarchy and specialization of a system of cities as a result of the dynamics of firms' interactions

The two main characteristics of systems of cities are the size distribution and the specialization of the cities. These characteristics have extensively been studied by geographers (Christaller, 1933; Berry, 1964; Pred, 1977; Bourne, 1984; Pumain, 1982; Batty, 2005; Pumain et al., 2006), and more recently by physicists (Makse et al., 1995; Schweitzer, & Steinbrink, 1998; Bettencourt et al., 2007). All this literature underlines the remarkable constancy in space and time of Zipf's law of distribution of city sizes (Zipf, 1941). Alongside the urban hierarchy, the degree of cities' economic specialization follows an opposite trend to the size. It has been shown that the sole account of the diffusion of innovations across the network that cities form, is necessary and sufficient to reproduce the observed characteristics of urban systems (Bura et al., 1996; Pumain, Sanders, 2013). However, the developed models always considered the entire city as the unit in

the urban system like in the Simpop model (Pumain et al., 2017).

In our approach, we propose a model where the cities forming the urban system are the results of micro-agents' interactions. This model also aims reproducing hierarchy and specialization of urban systems, but with a complete bottom-up approach from the micro-agents, to the meso level of each single city until the macro level of system of cities. We use an agent-based model where agents are firms that make evolve their cooperation network for innovation in a geographical space. Innovations stem from a firm, or a group of firms that cooperate and propagate across them according to their geographical distance and their position in the agents' network of cooperation. We will underline to what extent this basic model will be able to reproduce the urban system hierarchy. In a second step we will add a supplementary economic dimension that consists in different economic sectors. The new economic space combined with the geographical one will modulate the interaction patterns. In this configuration of the model, we will identify the necessary conditions to reproduce both hierarchy and specialization of urban systems.

2. Denise Pumain
From theory to modeling: which economics for evolutionary geography?

We observe a lack of communication between urban theories that are built with an economic or geographical focus, which may hamper the cumulativity of urban knowledge and be detrimental to the quality of urban predictions and prescriptions for urban policies. We review and discuss here how economic principles were integrated into geographical models simulating the spatial and economic development of systems of cities in a territory.

When modeling the dynamics of systems of cities from a geographical perspective we are confronted to a paradoxical situation: we have to acknowledge the key role of economic development as being causal (albeit it is a circular causality) in the progress of urbanization, as well as being responsible of the major structural feature of systems of cities (differentiation between cities in terms of size and functions) and deeply influencing the historical trajectories of individual cities. On the other hand, economic theory itself provides little clues for introducing principles in dynamic models of urban systems which would enable reasonable fitting to observations. Main difficulties are related to the concept of agglomeration economies that are defined for an isolated city, the conception of equilibrium versus open dynamics and the search for universal models. The hybridation of theories is obviously a necessary option.

We shall review which decisions were taken regarding the introduction of economic concepts and principles in the series of the Simpop simulation models, between 1996 and 2016, that were conceived for reconstructing the trajectories of cities as observed in systems of cities for a diversity of countries and time periods.

3. Antonin Bergeaud; Simon Ray
Adjustment costs and factor demand: new evidence from firms' real estate

Adjustment costs impair the optimal allocation of production factor across firms. In this paper, we use the cost associated to corporate relocation to explore the effect of the adjustment costs of the premises size on factor demand. We rely on the tax on realised capital gains on real estate asset that entails varying real estate adjustment costs across firms to empirically study the effect of these frictions on firms' behaviour. We develop a general equilibrium model with heterogeneous firms that sheds light on the implication of the level of the fixed costs associated with the adjustment of real estate on the change in firms' labor demand following productivity shocks. This model predicts that employment growth of firms facing positive productivity shocks shrinks with the level of the frictions. Confronting these results using French firm-level data over the period 1994-2013, we find that higher adjustment costs constrain relocation and reduce job creation of the most dynamic firms. The highlighted frictions has noticeable macroeconomic effects.

4. Clementine Cottineau; Elsa Arcaute; Max Nathan
Geoindustrial clustering of London businesses: modelling firms' trajectories and their interaction with the urban fabric

The industrial landscape and built environment of London has changed considerably in the past few decades, for instance with the emergence of a creative and digital cluster around Old Street and East London (referred to in policy documents as 'Tech City' or the 'Silicon roundabout'). However, the interaction and competition between a moving sector of startups with flexible office needs and latent gentrification processes in the housing market makes the spatial anchor of businesses uncertain and mobile. To evaluate the potential directions of this (and other) cluster's expansion, we put in place a new way of defining geoindustrial clusters, based on a joint measure of spatial proximity and of industrial proximity. Clusters of small areas are delineated for different intervals of a percolation analysis derived from firm level data. We analyse the evolution of these clusters and trajectories of individual establishments between them over the last fifteen years. This analysis provides a basis for undertanding and modelling their dynamics in terms of single firms growth, co-location strategies and interaction with the built environment into a multiplex networks framework.

3B - Spatial Analysis: Clustering

1. Richard Harris; Dewi Owen; Rory Kramer
Modelling Processes of Urban Ethnic Desegregation using Multilevel Indices of Segregation

Within the literature on measuring ethnic (de-)segregation, multilevel analysis has been promoted as a tool to evaluate changes in both the numeric and geographic scales of segregation between time periods for population groups within a study region (see, inter alia, Leckie 2012, Leckie and Goldstein 2015, Jones 2015, Harris 2017). This paper will use the multilevel approach to show how multilevel indices of segregation can be used to model processes of urban ethnic (de-) segregation, taking a hypothetical example as demonstrative and then applying the approach to consider intercensal change in the top 100 largest Metropolitan Statistical Areas in the United States.

Whereas traditional indices, such as the index of dissimilarity (ID), "have in common the assumption that segregation can be measured without regard to the spatial patterns of [population groups] in a city" (Duncan and Duncan 1955 p.215), the same is not true of its multilevel equivalent, the multilevel index of dissimilarity (MLID) (Harris, 2017). Instead, the MLID looks at the two principal dimensions of segregation in tandem, which are unevenness (a measure of spatial heterogeneity captured by the standard ID) and spatial clustering (a measure of the scale of segregation, which is not). By looking at both together, changes in the spatial pattern of segregation are reflected in changes to the multilevel measures of variance even when the overall ID score is unchanged. Considered in terms of the classic analogy of a checker or chess board, if some of the black and white squares are 'flipped' in colour thereby changing the scale of the black-white patterning then the multilevel index, unlike the traditional ID, will detect the change. In addition, the multilevel approach measures scale effects net of other scales in the model. Here it differs from other multi-scale approaches, notably 'egocentric' methods (Lee et al. 2008, Reardon et al. 2008, 2009, Spielman & Logan 2013, Hongwei et al. 2014), which measure aggregation effects – at how the measure of segregation changes with aggregation – but do not separate out how much of the measured segregation is due to each specific level of aggregation alone.

The paper will review the multilevel approach and its implementation as a Multilevel Index of Dissimilarity within the R package, MLID. Have done so the case study will be presented, looking at patterns of ethnic segregation in the United States in 1990, 2000 and 2010 and their changing scales. Finally, some of the short-comings of the approach will be considered, as well as its extension into a multigroup index (a multilevel version of the entropy measure, Theil's H).

2. Roger Bivand; David Wong
Comparing implementations of global and local indicators of spatial association

Measures of spatial association, and especially of spatial autocorrelation have been made available in many software applications. Measures may be global, applying to the whole data set under consideration, or local, applying to each observation in the data set. Methods of statistical inference may also be provided, but these will, like the measures themselves, depend on the support of the observations, chosen assumptions, and the way in which spatial association is represented; spatial weights are often used as a representational technique. In addition, assumptions may be made about the underlying mean model, and about error distributions. Different software implementations may choose to expose these choices to the analyst, but the sets of choices available may vary between these implementations, as may default settings. This comparison will consider the implementations of global and local Moran's I, G and Geary's C, and other measures available in a range of software including GeoDa, ArcGIS, R, Crimestat, and others.

3. Emily Sheard; Nick Malleson; Mark Birkin
Exploring the Spatio-Temporal Distribution of Car Key Burglary in West Yorkshire: Routine Activity or Planned Behaviour?

Much has been written about repeat victimisation, particularly in relation to residential burglary, and the associated theory underpins a number of crime models. It is, however, important to note the distinction between different area types and the nature of repeat offending patterns therein as this is likely to have implications for crime prevention. Johnson and Bowers (2004, p.252), for example, suggest that more affluent areas tend to experience more near-repeat domestic burglaries, whereby offences cluster in both space and time, but less affluent areas are generally more susceptible to exact repeats. Given the literature on high/ low offender rate areas and the journey to crime, it is anticipated that temporal clustering of near-repeats will be most marked in more affluent areas i.e. related offences will follow initial events in quick succession. Recognising that transient hot spots can limit the opportunity for reactive intervention, this research will seek to develop a dynamic risk model for the prediction of temporally clustered crime series.

Car key burglary will be used to inform the development of the model because this modus operandi is typically expected to present in more affluent areas (desirable vehicles) and also points to a more 'professional' offender profile than 'conventional' burglary. Initial analysis will be performed on police recorded crime data, both to test the validity of the research hypothesis, namely that the spatio-temporal signature of car key burglary differs to that of conventional burglary, and to identify potential risk factors for inclusion in the model. The analysis will take the form of three key stages; the first will consider the spatial distribution of offences in West Yorkshire and any relationships between identified heterogeneity and in-area/ neighbouring area characteristics, the second will examine the temporal distribution of offences, and the third will look for evidence of spatio-temporal clustering. Results will be presented at the conference and reviewed in the context of the environmental criminology literature and conventional burglary.

References:
Johnson, S.D. and Bowers, K.J. 2004. The Burglary as Clue to the Future: The Beginnings of Prospective Hot-Spotting. European Journal of Criminology. 1(2), pp.237-255.

4. Peter Mandl

Geographical Concepts and Reflections about Aspects of the "Digital Age"

It is said that we live at the beginning of the "Digital Age" This should influence all areas of life, especially also geography as a science. In contrast geography, its concepts, theories and way of thinking also impacts diverse aspects of the Digital Age. Such interdependency are presented and discussed in this paper.

First there is the spatio-temporal aspect in a digital world which is analysed and studied in geography since many years. Starting from the concepts by Thorsten Haegertstrand's "Time Geography", including the "Models of Spatial Processes" by Arthur Getis and Barry Boots and the reflections by Donna Peuquet about the „Representations of Space and Time" many ideas were described in the geographies of the 1970ies to the 1990ies. These concepts can be the basis for spatio-temporal analytics and predictions in a modern data-based view of the world. The talk shows what we can learn and deduce from these reflections.

The second aspect are the spatial big data, which are the base for many empirical studies undertaken in geography since decades. Starting with quantitative as well as structured data many years ago nowadays also qualitative as well as unstructured data, like texts, images, videos etc. are available and used. The schemes and models of open, linked and user generated spatial data, which have been developed in geography or for OGC specifications, are very important sources for the structures, links and processing models for spatio-temporal data in the Digital Age.

Reflections from the GI-Science, like the „Language for Spatial Computing" by Werner Kuhn or „The Language of Spatial Analysis" by ESRI are the basis for the third aspect, the functions, which use the big data in concepts to contribute to problem solving in the Digital Age.

These three aspects of the Digital Age, which are spatio-temporal-concepts, spatial big data and functions, are consolidated in some final best practice application examples presented, discussed and criticised in this talk. It will be clear that the Digital World is ubiquitous today. It is very useful as a modern pragmatic information tool if it is applied correctly and critically. In this talk it is shown and suggested what "geographical thinking" can contribute to the practice of the Digital Age.

5. *Matthew Daws*
Self-excited point process patterns in crime data

Existing methods of predicting crime (for example, burglary events) commonly make use of the (near) repeat victimization hypothesis: the tendency of victims of crime to, in the nearby future, to be repeat victims, and of near by (say) buildings to also be future victims. That is, a crime event at a spatial/temporal location tends to imply a higher risk, localised in space and time, for nearby locations. In the last few years, an explicit statistical model, the Self Excited Point Process, has been studied in relation to crime prediction. This was previously applied to Earthquake modelling, where one attempts to partition earthquakes into "background" events (which occur at random, but in an inhomogeneous way) and "aftershock" events, which are earthquakes caused by previous Earthquakes. There are clear parallels with the near repeat repeat victimization hypothesis, although it is far from clear if the exact parametric form of the model which is appropriate to earthquakes should be used to model crime.

We will discuss the use of non-parametric models in the existing literature, and some of the difficulties we have encountered in replicating these existing studies. We will then discuss some new semi-parametric models, and some of the techniques we used to deal with real-world data.

4A - Geography and economics 2

1. *Juste Raimbault*

Invisible Bridges? Scientific landscapes around similar objects studied from Economics and Geography perspectives

Understanding Science in a perspectivist approach (Giere (2010)), it is natural and necessary that disciplines or fields propose very different perspectives on real world objects. The yet-to-explore border regions at the interface, in which interdisciplinarity draws most of its strengths, are however not well understood in terms of processes of knowledge production such as domains cross-fertilisation, but also not necessarily the object of consensuses for research policies. We propose to explore these issues on the particular case of Economics and Geography, between which bridges seem difficult to build in the current state of disciplines. We take a Quantitative Epistemology approach, more precisely by combining citation network analysis with text-mining and semantic network analysis, using methods and tools developed in Raimbault (2016) to reconstruct what can be seen as a scientific landscape. We choose to work on two case studies of objects that have been extensively studied from both perspectives: Relations between Network and Territories, and Urban Growth. We constitute for each an initial corpus of key references in both disciplines, from which the backward citation network at depth two is reconstructed. We then collect abstracts for a significant proportion of nodes, extract relevant keywords, and couple the citation network with a semantic network which communities for example define endogenous research domains. Results overall show that as expected disciplines are highly clustered in terms of citation practice, but still form a fully connected graph. The communities correspond to clearly distinct contents in term of semantic landscape, with a good agreement between community structures in both networks. In the case of Network and Territories, intermediate or sub-disciplines emerge as communities in the citation network, as specializations on Accessibility or Transit-Oriented-Development that position at the interface of Planning, Geography and Economic Geography. Similarly, unexpected "newcomers" such as physicists appear at equal distance of Geography and Economics and may be an interesting direction to search for bridges. On the subject of Urban Growth, the distinctions are even stronger, with a final range of sub- disciplines spanning from technical GIS studies to entrepreneurship and "creative clusters" studies. This illustrates how each discipline has constructed its own objects and epistemologies, and how difficult it can be to actually work on a common object. It is interesting then to formulate assumptions on the role of auxiliary and neighbor disciplines in shaping research subjects of a given discipline, and in particular of performative branches that have rapid practical application (e.g. in socio-economic practices and policies for Economics, in Planning and Urbanism for Geography) that seem to simultaneously drive them apart but also bring new potential common objects (such as the "smart city"). We postulate that bridging approaches are closer than they seem but that they will require a high level of reflexivity and awareness of scientific landscape as this example illustrates.

References
Giere, R. N. (2010). Scientific perspectivism. University of Chicago Press.
Raimbault, J. (2016). Indirect bibliometrics by complex network analysis. In 20e Anniversaire de Cybergeo.

2.   Olivier Finance
Transnational investment decisions in and towards Europe: evidences for a single European system of cities?

Systems of cities exhibit several engaging properties like a "hierarchical and spatial structure as […] multiple interdependencies between cities belonging to the same country" [Bretagnolle et al., 1997] – or by extension the same region. In the case of Europe, evidences of the first properties have already been produced e.g. through Zipf's law [Bretagnolle et al., 1999]. Evidences of the functional unity of a European system of cities [e.g. Hall & Hay, 1980, Cattan et al., 1999] could be completed in a context of globalization linked with growing transnational economic interdependencies. Going further than national boundaries is essential as "the position of major cities in their national states have been redefined owing to the

multiplication of international communications" [Pumain D., Saint-Julien T., 1993]. The European economic policies, the processes of metropolisation, the restructuring of European companies, all "add up to a prospective restructuring of the European urban system, from a set of distinct national systems into something like a single integrated urban system" [Cheshire & Gordon, 1995]. But how far goes the functional integration in the case of the European urban system?

In this research, we use statistical modeling to explore if one of these interdependencies scales with city size in the whole Europe. Scaling laws, as one-parameter power-law relationships, are increasingly used in geography to describe quantities distributed in systems of cities [West et al., 1997 / Pumain et al., 2006 / Pumain, 2007 / Bettencourt et al., 2009 / Pumain et al., 2009 / Batty, 2013 / Arcaute et al., 2014 / Bettencourt et al., 2014 / Cottineau et al., 2016]. We will in particular observe transnational investment decisions between European cities and towards European cities, registered by the Financial Times from 2003 to 2016 into the fDi Markets database. If these scaling laws are useful and efficient to capture these decisions trends, we shall be able to conclude that European cities exhibit a consistency as a single system, further than a statistical addition of national systems [Bettencourt & Lobo, 2016].

These locational decisions reveal both the higher attractiveness of some cities and the transnational firms' location strategies in a context of economic globalization [Held et al., 2000 / Taylor, 2003 / Arrault, 2007 / Scott & Storper, 2014]. Considering these interrelations, territories are diversely integrated and excluded at various scales. We will especially explore the macro and meso levels of the European system of cities, much more appropriate than international comparisons, as "capital is global [and] work […] local" [Beck, 1999] and as cities are the major nodes of economic activities and globalized networks [Sassen, 1991 / Beaverstock et al., 1999 / Alderson & Beckfield, 2004 / Derudder, 2006].

We can expect a strong concentration of these decisions into the upper-part of the urban hierarchy, as it is the case in the French system of cities [Finance, 2016]. We can also expect some strong national and regional effects that may have to be regarded precisely to consider them into the statistical model.

3. Justin Delloye; Remi Lemoy; Geoffrey Caruso
Homothetic Scaling of Urban Land Use and Population Density Profiles in Monocentric Models

Urban scaling laws with respect to total population have become a major field of research in urban studies. However, the scaling properties of the population density profiles resulting from the monocentric models of urban economics are still unclear. This paper tests the ability of urban economic monocentric models to provide a theoretical foundation of the three- and two-dimensional homothetic scaling of the land use and population density profiles that were empirically identified by Lemoy and Caruso (2017)* for the 300 largest European cities.
First, two functional forms of the Alonso model with log-linear utility are proposed, respectively called Alonso and Alonso-LU models, with constant and exponentially decreasing profiles of housing land-use. Both land-use profiles are then calibrated using the empirical housing land use profile of Lemoy and Caruso (2017). Second, the population density profiles of the Alonso and Alonso-LU models are calibrated as well, using the empirical population density profile. Results show that the Alonso model is consistent with a three-dimensional homothetic scaling of the population density profile, and that it conjectures a scaling power of 1/3 that matches empirical evidence. Regarding the Alonso-LU model, it is not only consistent with a three-dimensional homothetic scaling of population density with power 1/3, but it also provides a much more accurate description of the housing land use profile which scales horizontally with power 1/2. However, the system-of-cities interpretation in terms of agglomeration economies suggests, for both models, that either households devote more than 50% of their income (net of transport cost) to housing, or that there exists a negative relationship between population size and transport cost. This result strives against the classic interpretation of transport cost as an agglomeration cost. Consequently, although the

Alonso-LU model provides a satisfactory description of the homothetic scaling of land use and population density profiles for European cities, it still presents some theoretical drawbacks.

* Lemoy, Rémi and Geoffrey Caruso (2017) "Scaling evidence of the homothetic nature of cities", arXiv: 1704.06508. This paper will also be submitted to the 2017 European Colloqium of Theoretical and Quantitative Geography (ECTQG).

4. Roger White; Gustavo Recio; Wolfgang Banzhaf
The Necessity of Disequilibrium

Classical theory in urban and economic geography was developed on the basis of the idea that systems tend toward equilibrium, and that they are thus predictable, since the equilibrium state is in some sense stable. This idea was borrowed from economics, and it continues to form the bedrock of that discipline. Much recent work in theoretical geography, however, involves dynamic modelling using such techniques as cellular automata and agent based modelling. These are essentially non-equilibrium approaches and are thus able to address phenomena that do not fit easily within the framework of formal economics—phenomena such as innovation and the evolution of form and structure. But economic factors are fundamental to the evolution and functioning of cities and regions, and so it is increasingly clear that we need to transcend the limitations of current equilibrium based economic theory.

To that end, we develop an agent based model of an economy consisting of producers (firms) and consumers. Firms are characterised by a location, a technology, and possessions—specifically money, capital, and a stock of inputs and outputs that have been produced but not yet sold. At each iteration, firms make a production plan which will require them to purchase inputs, hire labour, and use their technology to produce a product for the market. In general there are a number of firms using each technology, with each technology defining a sector. Some products are intermediate goods, used to produce other products, and others are final consumption goods. Consumers use their labour earnings to buy consumer goods. When profits in a particular sector are high, new firms appear to produce that product, which tends to lower the price. If a sector becomes unprofitable, some producers fail and disappear from the system. There are thus continual endogenous fluctuations in the system.

From time to time new technologies appear. Some of these produce an existing product using different inputs, usually in response to a high price of the product due to a shortage of the inputs required by the existing technology. Other new technologies produce a product that is new to the system. The appearance of a new technology frequently induces a brief period of great instability in the system as measured by profits or prices, accompanied by a lesser fluctuation in the number of firms producing in a sector. When all firms using a technology fail, that technology disappears from the system; in a similar way, products occasionally disappear. In general the tendency is toward increasing complexity, as well as increasing efficiency as less productive technologies are replaced by more effective ones. These fluctuations and trends represent the structural evolution of the system.

The model focusses on the dynamics and evolution of the system—or in other words on market instability and innovation—fundamental phenomena that cannot be treated in any systematic way within the framework of neo-classical economic theory. Because the firms require land and thus have locations, the model is essentially spatial and can thus address geographic issues related to economic change.

4B - Spatial Analysis: Visualisation

1. Robin Cura; Cecile Tannier

Visual and semi-automated exploration of an archaeological model: calibrating a model of spatial reorganization in North-Western Europe, A.D. 800 to 1100.

Most often, when building a model, the modeller has to choose between two types of methods for evaluating its model. (1) The "face validation", based on a visual and qualitative assessment of the model outputs, allows for a quick and direct feedback of the model behaviour considering the different values of parameters used. (2) More recently, and to have a more pervasive method of exploration, many modellers leant on High-Perfomance Computing to develop automated ways of exploring models often based on full factorial designs or on more parsimonious methods like genetics algorithms.

In this presentation, we advocate for combining the efficiency of the automated explorations and the qualitative feedback of face validation, in particular in a context of strong interdisciplinarity involving geographers, archaeologists and historians.

Our case study is a model of settlement system evolution over the long time that aims at a better understanding of the social and spatial processes that happened in North-Western Europe between 800 and 1100 A.D.

This period is characterized by a major change in the settlement system, to which we refer as the "800-1100 transition" (Tannier & al., 2014). The peasant households, mostly sprawled around 800, tend to cluster around functional attractors, mainly castles and churches. The clustering and fixation of households are at the origin of villages and small towns. With the Gregorian Reform, which led to a stronger religious control, a grid of parishes emerged around the churches.

We have introduced these processes in an agent-based model built with the GAMA platform, with the aim to test hypotheses on triggers and mechanisms that produced the observed changes. For example, it should help understanding if population growth is essential to the observed clustering.

Due to the lack and uncertainty of empirical data, the model mostly relies on expert qualitative knowledge. Consequently, we cannot define fitness functions or simple output indicators that would allow a fully automated evaluation of the model. Moreover, the model contains a large number of parameters. In order to find a first set of parameters so that the model reproduces a situation that experts would validate, we used two complementary approaches.

First, we carried out a semi-automated exploration based on rough parameters values, in order to restrain the parameters' space to analyse. To be parsimonious, even in the computation power required, we limit this exploration to the most obvious parameters affecting the simulation results.

We then used a visual approach, based on multiple display types to allow the specialists to understand and assess the output of an experiment. For this, we used GeoVisual Analytics methods introduced in a custom platform dedicated to the analysis of long-time spatio-temporal simulation data.

This communication aims at presenting the way those seemingly opposed parametrization methods have been articulated, and the simulation results thus obtained.

References:
Tannier C., Zadora-Rio E., Leturcq S., Rodier X., Lorans E. (2014). « Une ontologie pour décrire les transformations du système de peuplement européen entre 800 et 1100 », Ontologies et modélisation par SMA en SHS, Denis Phan.

2. Pierre Frankhauser; Olivier Bonin
Error terms and uncertainty in fractal radial analysis

In fractal analysis of build-up areas in cities, determining the local fractal dimension is a rather common method, often called radial analysis. To proceed, a circle is drawn around a chosen build-up site, and the radius of the circle is gradually increased. At each step, the total number of occupied sites inside the circle is counted. This information allows estimating a local fractal dimension. Investigations have shown that this type of analysis enables getting information about ruptures in the spatial organization of build-up space on the scale of town sections (Thomas et al. 2010). This type of analysis can be replicated for each build-up site of the area. Then a map can be drawn, where for each build-up site its fractal dimension is represented by a colour code corresponding to its value. We call this multiradial analysis (Frankhauser 2015).

However, the fractal dimension can be tricky to estimate empirically. Indeed, error terms are highly correlated by construction because any void that is taken into account in disk with radius r will be taken into account for all radiuses larger than r. This correlation can bias the estimation of the fractal dimension if not cared for.

Moreover, uncertainties and empirical deviations to the fractal law can have power-law distributions, if they are linked to the fractal generator, or normal distributions if they obey some kind of central limit theorem. Thus, its is unclear if the fractal dimension is best estimated with log-log regression, or directly with power regression.

In this paper, we propose insights on these questions by testing on constructed fractals as well as on data on real cities the effects of different kinds of errors and deviations to the fractal law. We show that given the additive or multiplicative nature of errors some specific care must be taken during the estimation, especially to model the autocorrelation of error terms inherent to the radial approach. We try to separate the effects of grid resolution and orientation from other sources of errors, and to understand why direct estimation is numerically impossible in many cases. We propose a protocol to analyse the nature of the error term in the fractal estimation, and compare different ways to estimate the fractal dimensions with explicit modelling of error autocorrelation.

The better understanding of error terms in fractal estimation enables us to apply more safely the method to real urban fabrics, and to discuss the results. We apply the methodology to the French new town of Cergy-Pontoise that mixes historical cities, small villages as well as large urban interventions typical of the urbanism of the 70s and the 80s.

Frankhauser, P. (2015). From fractal urban pattern analysis to fractal urban planning concepts. Computational approaches for urban environments, geotechnologies and the environment, Marco Helbich, Jamal Jokar Arsanjani and Michael Leitner eds., Springer, pp.13-48.
Thomas, I., Frankhauser, P., Frenay, B., Verleysen, M. (2010). Clustering patterns of urban built-up areas with curves of fractal scaling behaviour. Environment & Planning B (Planning & design), 37 (5), pp.942-954.

3. Alessandro Araldi; Giovanni Fusco
Retail Activity and the City: Contribution from the Analysis of Urban Fabrics

In the last decades, the so-called third revolution in commerce is impacting and modifying retail distribution in cities (Desse and Lestrade 2016). While the first transformation produced a centralization of retail in department stores in city centres, and the second created the new concept of the shopping mall in the suburbs, the current one is introducing the new concept of omnipresence of sale activity. E-commerce and m-commerce represent new challenges for traditional retailers.

As a result of these societal and economic changes, the growth of retail vacancy has been detected in the UK since the late '80s; in the last 20 years, other western countries faced the same transformations. Vacancy ratios are not uniform in urban space: within the same urban region, vacancy rates evolve differently; macroeconomic tendencies are not sufficient to understand why some neighbourhoods are more affected than others by this process. The presence of retailers in a street or in a neighbourhood is a paramount aspect for the social life of a city (Jacobs 1961); aware of the evolving situation, local administrations implement policies of retail revitalization and urban requalification.

These policies would benefit from a better understanding of the influence of urban form on retail activities. Network analysis has been widely applied in this field of study in different cities with Space Syntax or Multiple Centrality Assessment. Nevertheless, other aspects of urban form could be considered as relevant for retail distribution (Svetsuk 2014).

In a different presentation at ETCQG we propose Multiple Fabric Assessment (MFA), a new automated approach in the analysis of urban form from the pedestrian point of view, considering the different components of urban fabrics as well as their spatial relations.

Here we cross-analyse the results of MFA with retail activity presence in the city. Traditional statistical analysis and Bayesian networks explore the relation between observable urban forms and the intensity and diversity of retail activity. The case study is the metropolitan area of the French Riviera (France). Historical data of retail presence (2000-2016) is considered in order to recognize divergent patterns in retail vacancy at a micro-scale. The aim of this study is also to identify which subset of morphological characteristics better describes the urban features favouring or hindering retail presence. Our analyses show that different urban fabrics are ecosystems for retail development more or less apt to fostering the different forms of retail offer. Not surprisingly, traditional small and medium retailers are better supported by traditional urban fabrics characterised by connective street networks and high-density, adjoining buildings.

A future research perspective will be the combination of configurational and urban fabric approaches to urban form in order to better understand small-scale variations of retail distribution.

Desse S. and Lestrade S (2016) Mutation de l'espace marchand. Presses University of Rennes.

Jacob J. (1961) The death and life of great american cities, Random House, New York

Sevtsuk A. (2014)"Location and Agglomeration: The Distribution of Retail and Food Businesses in Dense Urban Environments ". Journal of Planning Education and Research 34 (4): 374 93.

4. *Martin Charlton; Chris Brunsdon*
Using animation to visualise correlation structure in multivariate spatial data

Conventionally we used static displays to visualise relationships in multivariate spatial data. Such display can include scatterplots, boxplots, lineplots, and maps. However the challenge for multivariate data is being able to view several relationships at once. Scatterplot matrices become cluttered when the number of variables exceeds a relatively small number, and while principal component transforms allow us to concentrate on the most important relationships, a number of issues still remain. In particular (i) are such relationships stable over geographic space (ii) what level of sampling uncertainty manifest itself in the visualisations.

We propose to address these issues through the use of animated visualisations: in particular to highlight the effects of sampling variability and spatial heterogeneity. This is achieved using open source software based on the R statistical and graphics programming language, together with other open source software tools. In addition these techniques lend themselves to web-based resources to explore these visualisation approaches and all techniques are fully reproducible.

A number of examples will be given in the presentation using dynamic visualisation applied to Irish socio-economic data

5. Monsuru Adepeju
Developing a hybrid hotspot approach for improving the accuracy of crime prediction

The ability of different crime hotspot methods to complement each other has been discussed in previous studies. This paper extends the idea of complementarity of the hotspot to develop a hybrid approach in which outputs of multiple methods are combined in order to improve the predictive accuracy. A case study of Chicago crime is presented to demonstrate that a considerable level of accuracy can be gained by using the hybrid approach.

5A - Geography and economics 3

1. Eric Koomen; Diogo Vasco
Bridging geography and economics in local-scale land-use modelling

Models that simulate land-use patterns often use either geographic, inductive, data-driven approaches or deductive, economic theory based methods to describe the relative strength of the social, economic and biophysical forces that steer the spatial patterns in the various sectors in the land system. This presentation proposes an integrated framework that incorporates both approaches based on a unified assessment for local land suitability following a monetary, utility based logic. The framework is illustrated with a hedonic pricing analysis of urban land values and a net present value assessment for agricultural production system in combination with statistics-based assessments of land suitability for other sectors.

The results show that limited difference exists between the most commonly applied inductive approaches that use either multinomial or binomial logistic regression specifications of suitability. Land-use simulations following the binomial regression based suitability values that were rescaled to bid prices (reflecting relative competitiveness) perform better for all individual land-use types. Performance improves even further when a land value based description of urban bid prices is added to this approach. Interestingly enough the better fitting description of suitability for urban areas also improves the ability of the model to simulate correct locations for business estates and greenhouses.

The simulation alternatives that consider the net present values for agricultural types of land use show the relevance of this approach for understanding the spatial distribution of these types of land use. The combined use of urban land values and net present values for agricultural land use in defining land suitability performs best in our validation exercise. The proposed methodology can also be used to incorporate information from other research frameworks that describe the utility of land for different types of use. Initial applications of this novel methodology in operational land-use modeling frameworks indicate their value for spatial policy preparation.

2. Zahratu Shabrina; Elsa Arcaute; Richard Milton; Michael Batty
Modelling Accessibility of Airbnb in Greater London Area

The growth of Airbnb, a Peer to Peer (P2P) platform for short term rentals, has increased exponentially since its establishment in 2008. The data from Inside Airbnb, which has collected publicly available information of Airbnb listings, shows that in March 2017 there were more than 53,000 listings in London alone. There has been a significant increase of Airbnb listings in only nine years since it was first introduced in London where most of these listings are located in Tower Hamlets, Hackney and Westminster area. This paper investigates how optimal the locations of Airbnb are by computing accessibility measures using gravity-spatial interaction models for Greater London. The accessibility of Airbnb depends on the relative location of Airbnb (origins) compared to the tourist attractions (destinations) assuming that the majority of the people who stay in Airbnb come to visit and travel to these touristic destinations.

We apply the accessibility model to predict where the next Airbnb might be located using several steps. First, we aggregate the surviving Airbnb count according to LSOA (Lower Super Output Areas) 2011 boundaries in London. The Airbnb data that we have are the rental outlets that survive and are still available in 2017 where all the outlets from 2008 are considered. For the purpose of the research, we only use Airbnb listings that have one of more reviews as a proxy for active listings. Second, we create an accessibility matrix of all LSOAs with the 90 tourist attractions in London that have information on the number of annual visits in 2015. Then we compare this with the matrix of 3579 LSOA that have one of more Airbnb's and compute the accessibility as a function of attractiveness (number of visits to tourist attractions) and cost (time and rent). We use Open Trip Planner, an open source multi-modal trip planner, to calculate the time to travel from each LSOA to the tourist attractions given a set of constraints including fastest routes as well as minimum number of mode changes as the time variable, and median house prices in LSOA level from Land Registry as the rent variable. We then compute the cost function to obtain the Airbnb accessibility score for each LSOA.

The model is fitted and calibrated to find the best fit compared to the existing Transport for London (TfL) data for the Public Transport Accessibility Level (PTAL) scores. The result provides input for predicting the optimised locations for Airbnb considering the cost function. Using the model, it is possible to pinpoint where the next Airbnb might locate. This is beneficial in informing the optimum utilisation of this type of digital innovation that changes rapidly and influences the city's urban dynamics. Overall, this paper contributes to providing important insights into the quantitative modelling of fast growing urban phenomenon such as Airbnb.

3. *Joris Beckers; Ivan Dario Cardenas Barbosa; Ann Verhetsel*
Modelling the urban layer in B2C e-commerce distribution networks

Online shopping is gaining popularity every year. From 2010 to 2014, Europe saw an average annual increase in online sales of 18% (Ecommerce Europe, 2015). With the surge of business to consumer (B2C) electronic commerce comes an increase in home deliveries (Hesse, 2002). Since most deliveries consist of a small number of items, the share of bundled freight flows decreases compared to traditional retail distribution processes. This increases delivery costs due to higher stop per parcel and higher emissions per parcel ratios (Gevaers et al., 2011). In addition, high competition in the parcel industry results in low demand densities for most players, being one of the major cost drivers (Browne, 2001). This, together with pressure from consumers and policy makers, pushes parcel carriers to innovate in order to balance the efficiency and sustainability of B2C deliveries. With the creation of distribution centres closer to the consumer, logistics carriers can contain most of mentioned problems within the last part of the delivery, i.e. the last mile, while the impacts of the B2C growth on the remainder of the supply chain are less profound (Fernie & Mckinnon, 2004). More recently, as an extension of the previous measure, carriers are expanding their pickup point networks to further minimize the distance to the consumer, hereby converting retail space into a logistics warehouse within the cities' borders, which we identify as the urban layer of e-commerce distribution networks.

In this paper, similar to earlier work (Clarke et al., 2015; Farag et al., 2006), we first identify the Belgian online shopper. Unlike previous publications, the goal here is not to assess e-commerce penetration in itself, but to test whether population density suffices to model e-commerce demand, or that a demand density based on the socio-economic characteristics of the population is necessary. To verify this, we conduct a statistical analysis of a survey that polled the online shopping behaviour of over 1500 internet users. These results serve as input for a geographical model that compares the spatial pattern of both the predicted demand density and population density. In a second step, the model outcomes are used to assess the current pickup point networks in the case of Antwerp, Belgium.

From the statistical analysis, we conclude that there is no significant difference between the probabilities of urban and rural internet users to shop online. Further it was clear that the well-educated male in his thirties with a good job seems to be more eager to shop online, which is similar to previous findings. The geographical model proved that modelling solely based on population density would significantly over- and underestimate the demand in certain areas. This was especially the case in poorer urban regions, suburban Belgium and the most rural areas of the country. Given that many models, both academic and professional, equate the population density with the delivery density to calculate delivery costs or sustainability impacts, significant errors will occur in certain regions. Ignorance of these errors may lead to miscalculations of both internal and external costs.

5B - Textual Big data

1. *Francoise Lucchini; Leny Grassot; Julien Baudry; Olivier Gillet; Bernard Elissalde*
Social networks, events and cities

Based on the recorded geolocated Twitter messages, our paper attempts to identify the urban rhythms by selecting the various modes of urban events from the urban routine. We tried to link the relationship between type of users, type of events and the transmission of messages on the Twitter social network for Paris and the Ile de France region.
In this area tweets have been recorded in 2015 from May to November. The corpus gathered reaches an amount of 1,300,000 geolocated messages sent excluding duplicates. We focused on several types of events like: sports, rock music festivals, or terrorist attacks.
To do this, we used methodologies of graphs that enable to combine spatial and temporal simplifications. Our method shows the spatio-temporal variation of nodes and flows for long time series of spatial situations.
The locations and rhythm of tweets emitted in this territory, reveals recurring places or others places with sporadic activity. For the same urban space, whether hotspots can be easily detected, there is a great variability of frequencies and rhythms. This lack of automaticity and this kind of arrhythmia make it possible to approach temporary clusters and discontinuity in the urban space. According to whether the event is singular or cyclical, planned or unforeseen, whether it takes place in a single place, following a route or tends to appropriate a specific neighbourhood, these tweets highlight chronotropic urban spaces.

2. *Marion Maisonobe; Laurent Jegou; Beatrice Milard; Michel Grossetti; Denis Eckert*
The world geography of scientific visibility: a deconcentration process (1999-2012)

Because of the international scope of scientific activities, studies on scientific activities speaks directly to debates in urban studies literatures about globalization.
For some researchers, increase in exchanges implies a focus on mobility rather than on stable social entities (Urry, 2007; Adey, 2014). For other authors, this fluidity of exchanges benefits first to very large urban agglomerations, sometimes referred to as "world" or "global" cities (Sassen, 1991; Taylor, 2004), whose privileged situation and visibility allows them to capture the flows of resources and people and create more wealth than others.
This communication aims to ascertain whether the territorial redistribution observed in the geography of scientific production between 2000 and 2007 (Grossetti et al., 2014) translated into a redistribution of the geography of citations, and therefore of scientific visibility.
Are publications from formerly marginal locations able to influence researchers based in "world cities", or is their impact mostly "provincial"?
Because the distribution of citations is extremely asymmetrical (Larivière et al., 2010), it could very well be that the geographic de-concentration of production activities did not lead to the geographic de-concentration of citations, but instead contributed to creating increasingly asymmetrical flows of

information for the benefit of "central" cities and countries.

This communication aims to verify whether this is the case by analysing the geographic distribution of citations received over a 3-year period by publications produced between 2000 and 2007, using a method for localising the publications indexed in the Web of Science by urban areas.

Results show a growing convergence between the geography of scientific production and that of scientific citations. The number of citations received by the world's 30 top publishing countries and cities tended to edge closer to the global average. While Singapore, China, India and Iran suffered from a deficit of visibility in 2000, their level considerably improved by 2007. Moreover, a decrease in the discrepancy between cities' scientific visibility has been observed in almost all countries of the world, except for three: Sweden, Egypt and Denmark.

To finish, our results show that the gap between the share of citations and the share of publications has decreased across all disciplines. A significant asymmetry in favour of English-speaking countries has remained in the distribution of citations in humanities and social sciences (but it is diminishing).

References

Adey, P., Bissell, D., Hannam, K., Merriman, P., & Sheller, M. (2014). The Routledge Handbook of Mobilities. London: Routledge.

Grossetti, M., Eckert, D., Gingras, Y., Jégou, L., Larivière, V., & Milard, B. (2014). Cities and the geographical deconcentration of scientific activity: A multilevel analysis of publications (1987-2007). Urban Studies, 51(10), 2219-2234.

Larivière, V., Macaluso, B., Archambault, É., & Gingras, Y. (2010). Which scientific elites? On the concentration of research funds, publications and citations. Research Evaluation, 19(1), 45-53.

Sassen, S. (1991). La ville globale : New york, Londres, Tokyo. (D.-A. Canal, Trad.). Paris: Descartes & Cie. 1996.

Taylor, P. J. (2004). World City Network: A Global Urban Analysis. London: Routledge.

Urry, J. (2007). Mobilities. Oxford: Polity Press.

3. Denis Eckert; Marion Maisonobe; John Harrison; Francis Harvey
The evolving geography of academic places in France, Germany, and the UK (1999-2014)

The full geocoding of the addresses contained in the Web of Science database (1999-2014) allows to perform a bulk of geographical analysis on the distribution of academic research and its evolution in the last 25 years.

The current geography of academic research, i.e. the spatial distribution of research activities, is of major concern for funding agencies and governments in all major European countries. These public or semi-public bodies are willing to promote and finance an "optimal" spatial distribution of research, in order to foster the development of knowledge-based society. This has led in the last 25 years to a bulk of targeted policies aiming at associating fundings with the promotion of spatial concentration of science (the typical example being "excellence" policies in Germany –Exzellenzclusters- or in France: Politiques d'Excellence such as Labex and IdEx). However, there is a significant lack of empirical evidence that would support the effectiveness of such policies. Such policies rely on "commonly held beliefs" (Grossetti 2016) about the geography of scientific activities. Our idea is to mobilize most recent spatialized bibliographic data available (our main source being the Web of Science / Science Citation Index) in 3 major European countries: France,

Germany, and the UK, in order to analyse and check
1- the actual spatial distribution of academic research in these 3 countries, and its evolution over time (1999-2014): are they concentration or specialization trends, or not?
2- the coherence of these evolutions with the funding policies, in order to assess the effectiveness of funding schemes associating « critical mass effect » with spatial concentration.

We will, for that purpose, use the most recent data geocoded by our research teams during the course of previous research projects (30 million addresses of papers registered in the Web of Science since 1999), extract all relevant data for Germany, France, and the UK, and propose some interpretations of the major evolutionary geographical trends, which could –or not, meet the expectations of the politicians and "experts" who have, over the last 25 years, designed most of public policies for the development of academic research.

References

Eckert, D., Grossetti, M., Jégou, L., Maisonobe, M. (2014), Les villes de la science dans le monde, Mappemonde, n°116, http://mappemonde-archive.mgm.fr/num44/articles/art14401.html

Grossetti, M., Eckert, D., Gingras, Y., Jégou, L., Larivière, V., & Milard, B. (2014). Cities and the geographical deconcentration of scientific activity: A multilevel analysis of publications (1987-2007). Urban Studies, 51(10), 2219-2234.

Harrison, J., Smith, D. P. and Kinton, C. (2016), New institutional geographies of higher education: The rise of transregional university alliances, Environment and Planning A, DOI: 10.1177/0308518X15619175

Maisonobe, M, Eckert, D., Grossetti, M., Jégou, L., Milard, B. (2016), The world network of scientific collaborations between cities: domestic or international dynamics? Journal of Informetrics, http://dx.doi.org/10.1016/j.joi.2016.06.002

4. *Caterina De Lucia; Mark Bartlett; Pasquale Balena; Pasquale Pazienza; Diana Caporale*
Modelling the gap between tourist preferences and local knowledge as drivers of touristic attractiveness

Apulia Region is one of Italy's most visited tourist destinations for its beaches, food, local traditions, cultural and religious heritage. In 2015, the National Agency of Tourism ranked Apulia Region third among southern Italian regions in terms of tourist arrivals and Bari (the capital of the region) and its coasts results the most visited from foreign visitors. Similarly, in 2016 the UK Tourism Statistics ranked the Yorkshire (UK) among the top 10 most visited regions in the UK, with the city of York alone, with its famous Minster, among the top 5 most visited cities in the UK.
This work pursues two aims. The first one is to investigate on the main features that tourists expect from a place to visit. Furthermore, one aspect of tourism impacts on a place is that the visitor's interest and satisfaction is a source of community pride. This issues seems debated because residents take for granted their local resources. Resident perceptions of tourism is largely debated by the scientific community. Generally, the majority of studies focus on what residents perceive. Departing from these studies, the second aim investigates why residents perceive their own place of residence as a place of touristic attraction.
To achieve the above aims we use a decision tree and a stochastic approach to understand either the main features or what combinations of features of a place are important to visitors, and a text mining approach to uncover local knowledge as a driver of resident perceptions of tourism. The analyses are based on a survey conducted on social networks and consider a comparative case study between two different geographic locations, specifically Apulia in southern Italy and Yorkshire in the north of England.

The main results uncover main features moving tourist decisions to visit for a place and latent information of resident perceptions of tourism, help community participation in the two regions to close the gap between local and visitor attitudes to tourism; and support bottom-up tourism development and planning policies.

6A - Urban systems

1. *Gaetan Montero; Cecile Tannier; Isabelle Thomas*
On urban boundaries: three methods, three solutions for Brussels

Delineating urban boundaries is a challenging and important topic for researchers and planners: empirical analyses highly depend on the delineation of the study area and the limits of the cities are of particular interest as they change over time and space. Urban governance can't be conducted in an efficient way if urban boundaries are not clearly defined.

Many scientific methods exist to delineate urban borders. They are mainly based on functional and/or morphological criteria. We here limit ourselves to morphological analyses using the footprint of the built-up as sole input. The first two methods deal with "complex theory" and use respectively the Morpholim methodology - a geographical application of the fractal theory (Tannier et al., 2011) and, the Natural Cities methodology - a topological application of the complex network theory (Jiang and Miao, 2015). The third method is a more classical one using the Euclidean approach: a Local Density Index.

Each method leads to specific results (i.e. a different delineation of the urban space). The goal of this analysis is to measure and understand each methodology and where/why are the differences. What do they do exactly and what do they show? Specificities and biases are identified and illustrated using theoretical cities and an empirical analysis is provided on the Brussels Metropolitan Area in Belgium.

Morpholim measures a distance threshold showing a break in the organisation of the built-up at different scales and without any a priori delineation of the tructure. The presence of a diffuse periurbanisation and/or the presence of a built corridor between two distinct urban structures deeply influence Morpholim results. The absence of contiguity in the Natural Cities methodology, and the use of the centroid of ground surface area of the buildings instead of the cadastral details, explain why the Natural Cities methodology ends up with urban spaces that correspond to the clustering of minimum three centroids. The Density methodology is subject to the well-known "Modifiable Area Unit Problem" and is unable to measure the geographic organisation of the footprints of the buildings.

The application of the methods on the Brussels Metropolitan Area allows to confirm that morphologically Brussel sprawls out of its administrative boundary and that each method leads to a different delineation. We already know that the delineation of functional cities deeply depends on the data/method used and that morphological delineations are different from any functional ones (Thomas et al., 2012). This paper further proofs and reminds that method matter for morphological delineations
as well and that one is not better than the other; they are simply measuring other things. Indeed, cities can be seen as (1) "hot spots" of buildings (Natural Cities), (2) fractal patterns that differ from their surrounding (Morpholim) or (3) areas having a high-density occupation of the space (Density Index).

2. *Pavel P. Em*
Is there any link between fractal dimension and service companies' entropy in Moscow and Seoul?

Moscow and Seoul are the economic hearts of their respective countries. However, due to their vast urban sprawl, the level of economic development and the lifestyles of the residents living in the various parts of these cities differ greatly. This study is an attempt to estimate the relation between the degree of

uniformity, the density within the build-up areas, and the distribution of service companies. A fractal dimension was used to quantify the level of uniformity within the built-up areas. Special maps were made by using the contours of all the buildings available from Google Maps, and then analyzed using Fractalyse software. The entropy index was used for the same purpose, but in the case of service enterprises. All of them were marked as points on a map in different colours representing their function. The location information was based on Yandex Maps for Moscow and Daum Maps in the case of Seoul.

Having marked all of the service enterprises as points on the map, the studied area was subdivided into squares with a line length of 0.5 km. The total saturation of all of the squares was then calculated. Only 0.4% of the squares encapsulated more than 70 companies, while almost half of them encompassed no more than 10. Metro stations attract service companies, but most of them cannot afford to locate themselves within the same square as the metro station due to the high rental price. Notwithstanding, the main part of them are situated in the squares neighbouring those with the station.

The fractal dimension and the entropy index vary dramatically within different districts of the studied cities. The uniformity level in built-up areas in the central part of Moscow is less than in the rest of the city due to the prevalence of buildings no more than 3-stories; thus Moscow developed outwardly in concentric rings and the majority of all of the buildings within the Garden Ring Road were constructed before the Revolution of 1917. The uniformity of service company location is higher in the newly-developed areas of Seoul in comparison with the districts built just after the conclusion of the Korean War. The level of uniformity of service company distribution is higher in the western and northern parts of both cities. The exception is the location of sport clubs, stadiums, car services, shopping and consumer service centers which almost in all cases are located close to the metro stations. Furthermore, accommodation service points are always located close to the railway stations. The distributions of postal services and beauty salons demonstrate the highest degree of uniformly.

To quantify the degree of the relationship between the fractal dimension for built-up areas and the entropy index for the location of service enterprises, a correlation index was calculated. This value varies between the two cities at 0.52 in Seoul and 0.57 in Moscow, which signifies the presence of a moderate degree of a relationship between these indices.

3.   Giovanni Fusco; Alessandro Araldi
Multiple Fabric Assessment: Exploring the Forms of a Metropolitan Area.

Quantitative protocols for the analysis of urban form through geoprocessing have thrived during the last thirty years. This paper presents a new protocol for the analysis of the forms of urban fabrics and its application to the case study of the metropolitan area of the French Riviera (France).

Urban fabrics are mesoscale patterns of urban form defined by the spatial relations between buildings, streets, parcels and site (Conzen 1960, Caniggia and Maffei 1979). Urban morphology has proposed quantitative and qualitative analysis of urban fabrics, both in the study of morphological processes and in urban design (Borie and Denieul 1984). Geoprocessing protocols have differently implemented the approaches of urban morphology, according to the focus and the ultimate goals of the analysis (Marshall 2005, Long and Kergomard 2005, Pinho and Olveira 2009, Berghauser-Pont and Haupt 2010, Gil et al. 2012, Hamaina et al. 2013). The identification of consistent spatial patterns has often been overlooked, leaving the question of morphological regions outside the research agenda.

Multiple Fabric Assessment (MFA) proposes a new way of defining observable urban fabrics from the pedestrian point of view. Accordingly, it uses street segments to create new basic units of analysis. MFA couples morphological indicators addressing the multidimensionality of urban fabrics with geostatistical analysis of significant spatial patterns and Bayesian identification of urban fabric types. Using as inputs

usual digital maps, MFA is conceived for the analysis of metropolitan-wide areas. The goal is to identify urban fabric types and morphological regions and produce a new analysis of the organization of the contemporary metropolis, based on the observable forms of the physical city.

The case study of the French Riviera shows how traditional urban fabrics are complemented by new suburban and connective fabrics, confirming the results of more qualitative studies. Above all, the analysis highlights the complexity of the emerging spatial organization of the metropolitan area. A first source of complexity allowed by the Bayesian probabilistic approach of MFA is the differentiation between core and peripheral areas for each urban fabric type: archetypical cores coexist with zones of overlapping characteristics, both in variable space and in geographic space. A second source of complexity is the juxtaposition of morphological regions of relatively homogeneous urban landscapes with others characterized by a fine mixture of different urban fabrics. A third source of complexity is the modular organization of the polycentric metropolitan area, coupled with trans-scalar self-similarity in the spatial arrangements of morphological regions. These results contribute to renewing the well-established frameworks of traditional urban morphology.

MFA is clearly susceptible of further improvements in the description of observable urban forms. Directions of methodological development will thus be highlighted. From an urban geographical perspective, comparative analysis of metropolitan areas and historical analysis of morphological processes within a given metropolitan area seem two important directions of further research. MFA also has the potential of contributing to the cross-analysis of urban form with socioeconomic phenomena linked to the human perception of physical forms.

4. *Brano Glumac; Marcos Herrera Gomez; Julien Licheron*
A residential land price index for Luxembourg: Dealing with the spatial dimension

This article introduces a residential (and mixed-use) land price index, based on original data allowing to merge transaction prices of land plots reported by notary deeds along with cadastral data and geo-spatial characteristics for all transaction recorded in Luxembourg from 2010 onwards. This database makes it possible to identify and locate all sales of available (i.e. non-constructed) land plots located in areas made for residential purpose (as indicated within the urban planning documents).
Luxembourg has been characterized for years by steadily increasing housing prices, stemming from an increasing gap between housing needs (steered by the economic and demographic growth) and new construction. The scarcity of available land and, probably more importantly, the difficulties for mobilizing the available land suggest that a specific index for assessing the evolution of constructible land is crucial for the design of urban planning, housing and tax policies.
After performing spatial dependence tests, an index based on a spatial hedonic model is constructed in order to cope with several identified spatial effects. The proposed index is a hedonic double imputed Fisher index, relying on a spatial Durbin error model. This hedonic model includes a rather large range of explanatory variables covering the physical characteristics of land plots, accessibility to employment and transportation, proximity to amenities, as well as environmental, legal and economic factors.
The proposed index is compared to results reached using alternative methodologies, with regards both to the type of hedonic modelling and/or the construction of the index. Finally, several robustness checks are conducted in order to assess the performance of the underlying hedonic model and the associated index regarding: i) quality of in-sample and out-of-sample prediction from the underlying hedonic model; ii) model coefficient stability over time; and iii) sensitivity to the procedure for detecting and eliminating outliers.

5. *Dani Broitman; Eric Koomen*
Living in historic cities: Intensification and increasing density gradients

Urban economic models predict that as transport costs decrease and population grows monocentric cities are expected to spread around their territory and their density profiles will flatten gradually. This prediction is empirically supported by a plethora of studies about urban densities development form all over the world. There are examples of exceptions to this rule, but they come from countries with extremely strict urban regulations or historic-political reasons. In this paper we analyze the urban density development of Dutch cities during 2000 and 2012. The urban density trends observed in the country are in contradiction with the observations in several parts of the world: Most urban areas in the Netherlands are experiencing an increasing residential density, and, to a lesser extent, increasing population density. In order to evaluate the strength and the relevance of these increasing urban density trends we first assess the monocentricity of the main Dutch cities. Restricting the urban areas to a circular ring with a radius of 5 km we demonstrated that regarding residential and population gradients, the majority of the cities can be classified as monocentric using data from 2012. As a second step, we performed the same monocentric assessment with data from 2000 and compare the results with 2012. For the majority of the Dutch cities, both residential and population densities gradients are becoming steeper over time, contrary to the worldwide urban density flattening experience. In the few cases where this phenomena is not observed this can be attributed to governmental planning decisions, whether regarding large-scale developments or by the foundations of new towns in previous decades. Therefore, as a general conclusion we can claim that Dutch cities centers are denser as a whole and their density gradient has increased in 2012, compared with their structure at 2000. Although it is at odds with most of the urban growth literature, this finding is in line with some recent urban sociological research. The existence of historical monuments and cultural heritage sites is positively related to increasing densities. This relation is observed for the Dutch urban structure as a whole and, for individual cities, and is significant for the largest ones.

6B - Accessibility

1. Cyrille Medard de Chardon
Detecting optimal cut-through locations to increase pedestrian and cycling modal shares

Western society's transportation design of prioritizing the private car, over other modes, has created complex health, environmental and safety challenges (Cox, 2010). Sprawling cul-de-sac development patterns, especially in the UK and USA, since the 1970's have led to less-safe, less valued and lower density cities (Marshall and Garrick, 2010). The resulting road networks decrease proximity to services and entrench dependence on personal motorized transport. Lower densities and greater distances to possible destinations undermine alternative modes, such as bus, rail, walking and cycling. Such urban structures create vulnerability and social isolation for the young and old who have less access to private vehicles (Martin, 2007). Socially, this existing urban transportation land use is exclusive, benefiting the wealthier (Martens, 2006; Mercier, 2009).

The reorienting of urban transport can have health, social, justice, security and quality-of-life benefits while being preventive and increasing resilience to environmental and economic instability (Cox, 2010). While a long-term approaches can change development patterns, solutions are required to retrofit vulnerable urban designs.

Accessibility is based on mobility, the ability to access adequate transport, and the proximity of destinations (Cervero, 2005). Where either is lacking, such as proximity in conventional suburban cul-de-sac developments, alternative transport is weakened. This paper presents a methodology determining optimal locations of cut-throughs, pedestrian and cycling paths which exclude motorized vehicles, to shorten distances to services, such as shops and schools, in order to increase accessibility.

This presentation will cover the methodology, results and context for application in safe routes to schools and other services. The methodology has three steps. The measuring of euclidean and network distances

between neighbouring points within a grid. The identification of pedestrian and cycling barriers. The selection of optimal barrier zones to provide cut-throughs and increase accessibility the most efficiently. Not all barriers are harmful, some provide sound and visual protection against negative externalities (e.g., busy roads, trains and particular land uses) or have no destinations beyond them.

Finally, a demonstration of the tool created for public and political outreach will be presented. This platform allows the interactive visualization of cut-through creation in terms of multiple modelled modal travels and the overall estimated impacts on modal shares.

References
Cervero, Robert (2005). "Accessible Cities and Regions: A Framework for Sustainable Transport and Urbanism in the 21st Century". UCB Working Paper, UC Berkeley Center for Future Urban Transport.
Cox, Peter (2010). Moving people: Sustainable transport development. London and New York: Zed Books.
Marshall, Wesley E and Norman W Garrick (2010). "Street network types and road safety: A study of 24 California cities". In: Urban Design International 15.3, pp. 133–147.
Martens, Karel (2006). "Basing Transport Planning on Principles of Social Justice". In: Berkeley Planning Journal 19.1, pp. 1–17.
Martin, George (2007). "Global motorization, social ecology and China". In: Area 39.1, pp. 66– 73.
Mercier, Jean (2009). "Equity, Social Justice, and Sustainable Urban Transportation in the Twenty-First Century". In: Administrative Theory & Praxis 31.2, pp. 145–163.

2. Olivier Bonin; Pierre Frankhauser
Accessibility, Amenities and Needs - a conceptual framework for exploring households' satisfaction

The notion of accessibility is very frequently discussed in the context of planning. It comes also into play in LUTI models. In general, accessibility synthetises the generalised costs to access different kinds of resources from a given place. However, this concept remains somewhat ambiguous and rather normative. The cost function cannot be constructed as a simple transformation of distance since cognitive aspects come into play.

Generally, places that are taken into account (jobs, shopping facilities, leisure areas, etc.) can be deduced from surveys. However, this approach by activities remains descriptive and does not seek for the deeper reasons of frequenting certain places. This holds too when considering the influence of amenities in residential choice without referring to individuals' needs.

This paper enriches the concept of accessibility by seeking theoretical groundings to the reasons why individuals frequent different places. We make use of the concept of human needs (Maslow, 1954; Max-Neef, 1991; Ryff and Keyes, 1995; Ryan and Deci, 2000 among others) that also allows establishing a link to satisfaction. Investigations conducted by Tay and Diener in 2011 focused on exploring empirically this concept. This recent study showed that universal needs act as good predictors to assess subjective well-being. Needs and well-being seem to be linked in a comparable way on a world-wide level, even if cultural references may change the hierarchy of needs.

The theoretical approach of human need does not explicit how needs can be satisfied in a given cultural context, e.g. what kind of amenities correspond to different needs. It says even less of where these amenities should be localised and how they could be accessed, which are crucial questions for urban and land planners. However, the theory of needs provides precious information on the importance of these needs and their link to satisfaction. Thus, need theory can help selecting amenities and evaluating both distances and the rank of the amenity in an accessibility function.

This leads us considering the articulation between the theory of needs and amenities for the greater metropolitan region of Paris. We construct a matrix linking needs and satisfiers, the latter corresponding to amenities that are all geolocalised. Then our evaluation function computes scores for each location by assessing accessibility to amenities according to their distance and rareness, enabling us to compute an index summarising the easiness to satisfy human needs for households located here.

Maslow, A. (1954). Motivation and Personality. Harper & Row, New-York, ISBN 9780060419875.
Max-Neef, M. A. (1991). Human scale development. The Apex Press, New-York and London, ISBN 0-945257-35-X
Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. American Psychologist, 55, 68–78. doi:10.1037/0003-066X.55.1.68
Ryff, C. D., & Keyes, C. L. M. (1995). The structure of psychological well-being revisited. Journal of Personality and Social Psychology, 69, 719–727. doi:10.1037/0022-3514.69.4.719
Tay, L., Diener, E. (2011). Needs and subjective well-being around the world. Journal of Personality and Social Psychology 101, 354–365. doi:10.1037/a0023779

3. Julia H. Tabbita
Housing informality in the Buenos Aires Metropolitan Region: A quantitative-spatial assessment for regularization and land use policies

Housing informality is a growing and long-standing phenomenon in most Latin American cities. Over the last thirty years, despite the widespread implementation of regularization policies, low income households still access urban land and housing primarily through informal mechanisms. According to 2010 Census results, in Argentina more than a fifth of households in the Buenos Aires Metropolitan Region (BAMR) live in inadequate housing conditions. Although informal settlements located in inner-city areas differ from peripheral recently formed ones, regularization programs have not adequately considered the specific physical and spatial features of different types of settlements at a metropolitan scale. Nor have evaluations been made of the feasibility of upgrading informal areas with no access to the existent infrastructure and transport network. These unaddressed issues have led to adopting similar regularization strategies in highly different contexts with inefficient results. The purpose of this study is to identify and map different types of informal settlements in the BAMR using multivariate analysis and advanced quantitative spatial methods. The informal areas accessibility to the infrastructure and public transport network will also be assessed. The results are aimed at improving regularization policies to redress informal areas at a metropolitan scale in the BAMR.

4. Juste Raimbault; Solene Baffi
Structural Segregation: Assessing the impact of South African Apartheid on Underlying Dynamics of Interactions between Networks and Territories

Networks and Territories
Transportation Networks can be leveraged as a powerful socio-economic control tool, with even more significant outcomes when it percolates to their interaction with territories. The case of South Africa is an accurate illustration, as Baffi (2016) shows that during apartheid railway network planning was used as a racial segregation tool by shaping strongly constrained mobility and accessibility patterns. We propose to investigate the potential structural properties of this historical process, by focusing on dynamical patterns of interactions between the railway network and city growth. More precisely, we try to establish if the segregative planning policies did actually modify the trajectory of the coupled system, what would correspond to deeper and wider impacts.

Network Measures
We use a comprehensive database covering the full South African railway network from 1880 to 2000 with

opening and closing dates for each station and link, together with a city database spanning from 1911 to 1991 for which consistent ontologies for urban areas have been ensured. First, a dynamical study of network measures seem to confirm the hypothesis: a trend rupture in closeness centrality (defined for a node as the average travel time to other nodes) at a roughly constant network size evolution, at a date corresponding to the beginning of official segregative policies, suggests that the planning process after this date had in the best case no global effect on network performance, and in the worst case had intended negative effects on accessibility with the aim to physically segregate more.

Causality patterns
We then turn to dynamical interactions between the railway network and city growth. For that, we study Granger causalities, in the large sense of correlations between lagged variables, estimated between cities growth rates and accessibility differentials due to network growth. We test both travel-time and population weighted accessibilities, for varying values of distance decay parameter. We find that results are significant with travel-time accessibility only, autocorrelation dominating with weighted accessibility. A time-window of 30 years appears to be a good compromise between the number of significant correlations ($p < 0.1$ for a Fisher test) and the absolute correlation level across all lags and distance decays, what should correspond roughly to the time-stationarity scale of the system.We obtain therethrough clear causality patterns, namely an inversion of the Granger causality (lagged correlation up to 0.5 for several values of distance decay), from accessibility causing population growth with a lag of 10-20 years before the apartheid (1948), to the opposite after the apartheid (lag 20 years). We interpret these as Structural segregation, i.e. a significant impact of planning policies on dynamics of interactions between networks and territories. Indeed, the first regime corresponds to direct effect of transportation on migrations in a free context in opposition to the second one. Further work should consist in similar study with more precise socio-economic variables, for example quantifying directly segregation patterns.

References
Baffi, S. (2016). Railways and city in territorialization processes in South Africa : from separation to integration ? Theses, Université Paris 1 - Panthéon Sorbonne.

5. *Eusebio Odiari, Mark Birkin, Susan Grant-Muller and Nick Malleson*
The use of big data in spatial micro-simulation of railway passengers

In the absence of an attribute-rich, comprehensive and representative population, a simulated population is necessary for the analysis of complex mobility on the railways. Novel consumer datasets called 'big data' tend to have comprehensive specific coverage, but are not representative of the entire population. The detailed heterogeneity in these datasets can be better harnessed by integrating with other relevant datasets from measured stated surveys which are designed to be random samples representative of the population. In this paper both deterministic and stochastic spatial micro-simulation strategies are discussed for combining various datasets, creating a representative micro-mobility population of railway passengers embedded in the wider population within a geographic region (West Yorkshire, UK). A deterministic methodology particularly suited to adjust skewed rail-mobility consumer big data is developed, combining information on all rail tickets sold in the UK, with the 2011 Census commute to work data and a National Rail Travel Survey (NRTS), yielding a representative micro-level population. The deterministic strategy using multi-dimensional iterative proportional fitting is presented in a concise and accessible way, highlighting nuances, precautions in practical application, and associated advantages of the methodology. The simulated population created includes weights which represent the probability density for rail commuters, such that a sample of the synthetic population according to the density yields representative rail passengers, whilst a uniform sample yields the wider population sample. Such a synthetic population can be fed through a logistic GIS rail network to establish further passenger behaviour, creating a rich comprehensive dataset for subsequent analysis.

7A - Demographics

1. David Burg

Recurring Patterns in Urban Growth

The large cities of the world exhibit recurring macroscopic patterns of growth with populations expanding rapidly though the rate of growth decreases with time as the effects of constraints on the system become more significant. The aim of this research is to revisit and refine this approach. A detailed dynamical analysis was performed on population data of cities using the logistic model:

$P(t)=K/[1+e^{-(\ln(81)/a)(t-tm)}]$

where 'a' is the characteristic time for the process to grow from 10% to 90% and 'tm' is the inflection point bifurcating exponential and logarithmic growth phases. 'K' is the upper population limit; however, nonlinear fitting methods tend to underestimate this value. To alleviate this, we derive a reparameterization accounting for the coupling between a, K and the maximum growth rate, s. The advantage of this substitution is fitting the function to the linear phase of the logistic curve gives better estimates for the upper bound on population size when the process has not yet saturated.
The patterns demonstrated for large cities, as defined by administrative boundaries, Metropolitan Areas or 'natural cities', confirm the hypothesis that they exhibit recurring growth curves consistent with the logistic model. Each city has unique parameter values, even so, the narrow distribution of values for the growth rate constant suggests similarities of urbanization rates globally. Further, the data show decreasing growth rates in many cities throughout the last few decades. Taken together, these results may give insight into the dynamics of city growth for civic and national policy and conceivably predict outcomes of modern urbanization, in general.

2. Francois Bavaud; Theophile Emmanouilidis; Guillaume Guex
Handling social segregation in gravity modelling: a computable scheme

Spatial flows (migrants, commuters, journey to schools, goods transportation, financial transfers, communications...) define a matrix of counts between n origins O and m destinations D. Relative spatial flows specifies an empirical bivariate distribution, and define in turn a weighted bipartite network, or a weighted oriented network when origins and destinations coincide.

Spatial flows are traditionally modelled by the family of gravity models (see Simini et al. 2012 for a recent "radiation modelling" alternative), where origin and/or destination counts may by fixed, or not. In absence of exogenous predictors (distance or transportation cost excepted), gravity models for OD constrained flows can be derived from differing, yet equivalent formal schemes:
(a) Jaynes-like maximum entropy principle with given average transportation cost (Wilson 1967)
(b) model-based iterative fitting, following the information-theoretic alternating minimization framework (Csiszár 1975), or the EM-algorithm
(c) regularized optimal transportation problem, involving an additional origin-destination mutual information term I(O:D), making the solution unique and detecting boundaries between soft OD clusters (e.g. Guex et al.2016).

We propose a formally tractable extension of the gravity modelling by considering in addition a "social" categorical variable A with p types (such as nationality, ethnicity, social class, school performance, or gender), attached at the units at the origin O. Social types A and destinations D are conditionally independent given the origins O, and the mutual information I(A:D) defines a measure of social segregation.

Minimizing the "free energy" U+cI(A:D)+TI(O:D), where U is the transportation cost U, and c and T are suitable adjustable positive coefficients, turns out to yield a computable iterative scheme, yielding an unique optimal solution.

In particular, the distance versus segregation trade-off can be made explicit - an important prerequisite for informed planning decisions. Also, the social mixing parameter can be extended to negative values c<0, as in segregative planning, aiming to construct socially homogeneous destinations, such as schools preferentially provided to pupils of the same social category. Convexity breaks down for c<-1/T, paving the way for locally optimal distinct OD flows.

Quantitative "social" variables A (such as personal wealth, or school performance) can also be handled by the above scheme, under two variants:
(a) adjusting OD flows so as obtain (for c > 0) destinations made of aggregates
similar in the average and the dispersion of A
(b) only requiring a comparable average level of A among units at the same destinations.

Simulated examples, as well as real case studies (segregation in primary school assignment in Lausanne, Switzerland; Emmanouilidis et al. 2016) illustrate the theory.

References:

Simini,F., González,M.C., Maritan, A., Barabási,A.L. (2012). A universal model for mobility and migration patterns, Nature, 484(7392), 96-100.

Wilson,A.G. (1967). A statistical theory of spatial distribution models. Transportation research, 1(3), 253-269.

Csiszár,I. (1975). I-divergence geometry of probability distributions and minimization problems. The Annals of Probability, 146-158.

Guex,G., Emmanouilidis,E., Bavaud,F. (2016). Transportation clustering: a regularized version of the optimal transportation problem, submitted for publication.

Emmanouilidis,E., Guex,G., Bavaud,F. (2016). The transformed optimal transportation problem: sensitivity and segregation of the children-to-school constrained assignment in Lausanne, Proceedings of Spatial Accuracy 2016, 333-340.

3. Doignon Yoann
Which spatial convergence of demographic ageing in Mediterranean?

Theoretical framework
Convergence is a temporal process whereby the disparities between individuals decrease over time. The concept of convergence is appropriate for population studies. Typically, demographic transition is explicitly a process of convergence (Wilson, 2001). The population is converging from a young structure to an older one.
This work aims to study the convergence of demographic ageing, by explicitly integrating the spatial dimension and by using original methods, little used in demography. To this end, we chose the Mediterranean, characterised by a dichotomy between the southern and northern shore, with higher fertility and mortality rates on the former, and an older population on the latter. In years to come, this will cause a convergence of demographic ageing from the southern towards the northern shore. To do so will require us to carry out population projections. Finally, in light of the regional disparities, a sub-national

scale will be used for this study.

Empirical approach

To study the convergence of demographic ageing on an sub-national scale in the Mediterranean, we had to face several methodological challenges.

First, we created a sub-national grid for the entire Mediterranean. Each country possesses numerous administrative levels. However, for the purposes of a sub-national study, it was appropriate to select only one per country. To limit the effects of scale, we constructed a sub-national grid harmonised by surface area, that is, by choosing administrative levels of a similar average size.

Next, for population projections, we chose the component method over a 50-year period (2015-2065). This required a certain amount of data. However, there is no central data office for the Mediterranean area. We therefore collected this data from each national statistical office but also from specific surveys and international organisations.

This collection process yielded a highly heterogeneous set of data, as some countries have highly detailed data available, whereas in others, it is imperfect or summary. We then used demographic methods of indirect estimation to overcome these problems.

We then made projections using the component method, opting for a closed population. For the future development of fertility and mortality, we employed projections from the United Nations' World Population Prospects 2015. We adapted the UN's various development variants to our data (sub-national territories follow the same trend as the country to which they belong) to construct four prospective scenarios over a period of 50 years (2015-2065).

Using this data, the methods of econometrics and spatial econometrics were applied to measure the convergence of demographic ageing (σ-convergence, local σ-convergence, Markov chains, spatial Markov chains).

Results

First, the measure of σ-convergence shows an overall decrease in disparity over time.

We highlight convergence spatial clubs. Territories with the same trajectory are not randomly distributed in space. Space thus plays a key role in the convergence of demographic ageing.

Therefore, local σ-convergence shows areas of spatial convergence, but also of spatial divergence. The opposition between the northern and southern shores becomes much less marked in 2065.

Finally, we prove that the convergence process is thus heavily influenced by the spatial dimension.

4. *Khneyzer Chadi*

Lebanon between analogy and specificity of territorial development processes: The necessary originality of a credible development strategy for the Akkar

Since the end of the war (that began in 1991), Lebanon, a small Mediterranean country, has witnessed periods of significant economic growth, aided by the reconstruction process and supported by the public policies of the time.

Nevertheless, this growth was mainly quantitative, focusing on the capital Beirut, neglecting to a large extent the needs of regional development. A more comprehensive vision of integrated development has not been realized at national level. Development was even less in certain regions such as Akkar in northern Lebanon. However, simultaneously, Lebanon is found to have witnessed a fairly unique phenomenon for more than a decade, which can be described as a "counter-exodus" (reversed exodus) movement.

In fact, as the number of cities and metropolitan areas increases, and their influences become more pronounced in lifestyles and mobilities, more and more inhabitants of the city are returning to settle and live in areas considered to be rural or semi-rural areas.

The territorial economy in Lebanon is random and has no theoretical basis in its conception. We believe that this gap needs to be filled and that a territorial economic policy must be created in Lebanon to

manage the processes and rebalance the development dynamics.

On the basis of this observation, we wish to examine the reasons behind this "counter-exodus" (reversed exodus) and, in particular, to answer the following questions: How can we reveal the factors which support the development process that allows a rebalancing at the national level? What are the factors of territorial attractiveness in Lebanese rural areas that are strong enough to explain this inverse (in the opposite direction) mobility (movement or flow)? Based on the precepts of the territorial economy and the social and solidarity economy, we aim to study the opportunities for creating work opportunities in the agricultural and agri-food sectors that would resolve all social, economic, and financial imbalance through the conduction of an comprehensive territorial study.

In order to provide answers to this problem, several questions must be asked first: is there a development model implemented in the more dynamic Lebanese regions, which can be transposed (similarly implemented) to Akkar? If not, is Akkar so marked with irreducible particularisms that a specific strategy should be considered?

This study needs to situate our reasoning in the current context of Lebanon and therefore to address the following points:

- What kind of planning is needed to meet the needs of different types of territorial management?
- Is there a relay (relationship and communication) between the state and the local authorities at the local level?
- What trade policies should be chosen to improve security and food governance in Lebanon?
- What can be the future of agriculture in Lebanon (commercial or proximity, irrigated or rain fed, ecological or intensive.)?

Once these questions are examined and answered, it will be possible to create and draw an effective policy framework at the regional level so that the attractiveness of Lebanese rural areas is sustainable and conducive to local development.

5. *Anna Dmowska; Tomasz Stepinski*
Evolution of Racial Diversity in Newly Built American Housing Subdivisions

The United States is racially diverse as a whole but segregated at the local level. The local segregation has been previously studied at the level of metropolitan areas using demographic data aggregated to census tracts. Limitations in spatial resolution and year-to-year compatibility of census tracts make it impossible to study evolution of racial diversity at the fundamental local level of individual neighborhoods. Using recently developed (http://sil.uc.edu/webapps/socscape_usa/) 30 m resolution, year-to-year compatible demographic grids for 1990, 2000, and 2010 we tracked 2000-2010 evolution of racial diversity in housing subdivisions built between 1990 and 2000. First, we identified all 3,382 "new" subdivisions across the entire U.S. as urbanized areas present in the 2000 grid but absent in the 1990 grid. For each new subdivision we also identified its "neighborhood" – a set of pre-1990 subdivisions in the radius of 4 km to serve as a control sample; altogether there were 48,976 such control subdivisions. All subdivisions (new and control) are classified into one of three categories of racial diversity: low (L), medium (M), and high (H) based on the scheme developed in our previous work and using data from the 2000 grid. By comparing diversity category of newly built subdivisions with prevailing category of their pre-1990 neighbors we found that 24% of newly built subdivisions start as more diverse than their older surroundings, 11% are less diverse, and 65% conform to a diversity level of their surroundings.

Next we re-evaluated racial diversity of 1990-2000-built subdivisions and their older surroundings after 10 years by reclassifying them into diversity categories using the 2010 grid. We found that the majority (78%) of 1990-2000-built subdivisions maintained their diversity category after 10 years, 19% increased their diversity, while 3% decreased their diversity. Over the same time 68% of their older surroundings in the control set also maintained their diversity category, while 27% increased and 5% decreased their diversity. More in depth look reveals that the greatest increase in diversity within a set of control subdivisions is associated with those 1990-2000-built subdivisions which increased their diversity in the 2000-2010

period. Control subdivisions associated with 1990-2000-build subdivisions which remained steady or decreased their diversity experiences smaller increases.

Results of this comprehensive study are interpreted as follows. When a new housing subdivision is built its residents tend to be statistically more racially diverse than those in neighboring subdivisions. This is likely due to shifting social attitudes, changing income stratification, increasing minority population, and existence of anti-discriminatory laws. Over the 10 years period the diversity gap between the newly built subdivision and its older neighbors narrows, especially in the areas of the strongest overall diversity increase. If this trend continue, American suburbia (if not its inner cities) will become locally diverse in the next few decades.

7B - Big data

1. Tomas Crols; Nicolas Malleson
Quantifying the Ambient Population using Big Data and Agent-Based Modelling

Understanding and quantifying the number of people who are outside in urban areas (commonly termed the 'ambient' population) is an important research area with relevance across several disciplines. These include crime science (understanding the population at risk of crime) [1-3], environmental science (quantifying exposure to air pollution) [4], health and transport sciences (measuring the health impacts of diverse travel behaviours) [5], etc. Although abundant data exist to quantify the residential population, there has traditionally been a severe lack of reliable information regarding the ambient population. This has begun to change in recent years as the 'big data revolution' has led to the emergence of vast new datasets that describe human movement [e.g. 6] at high degrees of spatial and temporal accuracy. Examples of such data include vehicle traffic counters, mobile phone usage, social media contributions, public transport smart card use, etc. These datasets are extremely diverse, however, and there has been very limited work to reconcile these disparate data and create a single, robust measure of the ambient population.

This presentation will focus on ongoing work that is attempting to leverage traditional and 'Big' data sets to quantify the ambient population. The approach taken here is novel; the research programme proposes to use agent-based modelling as a means of simulating the ambient population at an individual level. 'Big' data streams will be used to calibrate and validate the model, ultimately in real time as they emerge. In this manner, the model will be able to incorporate data from a diverse range of sources, creating an up-to-date, realistic representation of the behaviour of the population as it travels around an urban area. Specifically, the paper will present the most recent results from a small case study in a town in Yorkshire, UK. It will demonstrate how a relatively simple model can produce estimates of the ambient population, and will validate these against estimates of the population that have been captured using Wi-Fi sensors to detect the number of mobile phones passing certain points in the town.

References

[1] Andresen, M.A., Jenion, G.W., & Reid, A.A. (2012). An evaluation of ambient population estimates for use in crime analysis. Crime Mapping: A Journal of Research and Practice, 4(1), 7–30.

[2] Boivin, R., & Felson, M. (2017). Crimes by Visitors Versus Crimes by Residents: The Influence of Visitor Inflows. Journal of Quantitative Criminology (online first).

[3] Malleson, N., & Andresen, M.A. (2016). Exploring the impact of ambient population measures on London crime hotspots. Journal of Criminal Justice, 46, 52–63.

[4] Park, Y.M., & Kwan, M.-P. (2017). Individual Exposure Estimates May Be Erroneous When

Spatiotemporal Variability of Air Pollution and Human Mobility Are Ignored. Health & Place, 43, 85–94

[5] Flint, E., Webb, E., & Cummins, S. (2016). Change in commute mode and body-mass index: prospective, longitudinal evidence from UK Biobank. The Lancet Public Health, 1(2), 46–55

[6] Kitchin, R. (2014). The Real-Time City? Big Data and Smart Urbanism. GeoJournal, 79 (1), 1–14.

2. *Arnaud Adam; Isabelle Thomas*
Revisiting the internal structure of Brussels with mobile phone data: theoretical revolution or data evolution?

With the advent of Big-data, new mathematical methodologies are currently used and developed to decompose a deluge of data into simple information. Applied to spatial datasets, they open new avenues for urban analyses by depicting the internal organization of cities and by measuring their spatio-temporal variations.

We here use mobile phone calls to delineate interaction patterns within the metropolitan area of Brussels; the Louvain Method is applied on almost 20 million mobile phone calls collected in April – May 2015. Using the origin and the destination of the calls, we detect communities of antennas that are tightly linked in terms of number of calls, during work and non-working hours and, with the introduction of a parameter in the Louvain method, these spatial groups are decomposed into sub-communities and further analyzed. The robustness of the results in terms of data and the methods are in-depth discussed. Moreover, the antennas are individually characterized in terms of the socio-economic conditions and the time dimension of the calls are hence considered.

Communities of mobile phone calls are compared and further discussed. Does the socio-economic conditions of places influence the organization of communities? Are some areas more active than others? Results show that (1) surprisingly, the communities of calls follow quite well the expected composition of the Brussels Capital Region and, furthermore can be easily related to the transport network organization, (2) the socio-economic conditions around the antennas help to characterize the interaction patterns within the metropolitan area of Brussels. This work shows that combining new and classical analyses for interpreting Big-Data allow to depict the urban complexity and opens new avenues for future research.

3. *Robin Cura*
Making large spatio-temporal data analysis easier: Illustrated plea for using (geo)Visual Analytics

In 1998, Peter Fisher advocated for an improvement of geographic data exploration, considering that "software tools need to be developed to transform data into intelligible views and exploratory tools. [...] It must be made much easier" (Fisher, 1998). For Andrienko et al. (2014), this issue "remains sharply pertinent nearly 20 years later".

Fact is, despite being able to rely on some very useful and praised tools like GeoDa, most of the geographical data is still explored and analyzed within the bounds of traditional GIS software, especially within the Theoretical and Quantitative Geography community.

Alan MacEachren (2017) called for a renewed use of (Geo)Visual Analytics. He especially insists on the opportunities that Big Data offers, pleading "for a 'human-in-the-loop' (geo)Visual Analytics approach to leveraging big (geo)data".

I suggest that this approach can also be applied to regular spatio-temporal large datasets. Together with the emergence of the "geodata science" and the growing complexity of analysis methods, most of the

recent research on this field focus on developing new complex methods. With today's computation power increase and more employable technologies, TQG community could make use of the simplest visual exploration methods that could not be applied on large dataset until recently. Among these, I consider traditional methods such as small multiples, linked views and filters, temporal as well as spatial and thematic.

In this talk, I'll present such a use on three large and inherently spatial and temporal datasets.
(1) The first comes from the Google Location History of an anonymous user. It consists of a frequent recording (every 3 minutes) of the user's smartphone location. Albeit the lack of contextual data, we will show how this mass of data can allow to gather very personal informations about the user.
(2) We also present an exploration of the CitiBike dataset. Originating from New-York City bike sharing system, it consists of a record for each trip. Together with spatio-temporal informations, thematic data like age and gender of users can help figure out different uses of the bike system through time and space.
(3) The last dataset is about transit : for multiple road segments, road-censors in Paris registers the car traffic every hour. Gathered over a year, this very large dataset can help detecting patterns and special events in the car flow.

Those datasets and questions were addressed by creating specific web applications dedicated to their visual exploration, and I will try to expose the generality of such an approach. A particular attention will be dedicated to showing how easy it can be to build such ad-hoc exploratory tools, and, more importantly, how simple it can be to use.

Andrienko G., Fabrikant S. , Griffin A. , Dykes J., Schiewe J. (2014). Geoviz: Interactive maps that help people think. International Journal of Geographical Information Science, 28(10)

Fisher P. (1998). Is GIS Hidebound by the Legacy of Cartography? The Cartographic Journal, 35(1)

MacEachren A. (2017). Leveraging Big (Geo) Data with (Geo)Visual Analytics: Place as the Next Frontier. In Spatial Data Handling in Big Data Era

4. *Horacio Samaniego; Mauricio Franco; Boris Sotomayor*
The Topology of Communicating Across Cities of Increasing Sizes, or the Complex Task of "Reaching Out" in Larger

Cities are quintessentially complex and a deeper understanding of urban dynamics will greatly benefit from recognizing the shared properties they have with a broader class of systems. Particularly, with complex adaptive systems who share coupled human-environment features organized around an ecology of social, economic, and structural components. In such context, cities have also been compared to social reactors constrained by the communication and coordination possibilities offered an urban environment that has only grown since the advent of industrial age.
We here attempt to provide a first description of human interactions in the urban environment using Call Detailed Records (CDR) of the major mobile phone communication network operator in Chile. We build communication networks for 145 Chilean cities to describe and characterize the communication behavior of urban dwellers. We center our analysis in observed indicators of social activity, such as the number of contacts, number of calls and total communication time in each city and evaluate their scaling relationship with the number of mobile assigned to each city as an approximation of city size. We attempt to unveil differences in cell phone usage patterns among leisure and working times by separating out analysis into two periods: working time (08:00-13:00 & 14:00-20:00 hrs.) and night hours (20:00-08:00 hrs & 13:00-14:00 hrs.). Surprisingly, the topological differences of network between the two periods are marginal. Interestingly, the values of scaling exponents closely match recent explanations proposed by Bettencourt

(2013). The topologies of cell phone networks usage among cities of increasing sizes are slightly assortative, albeit assertiveness' decreases with size. Additionally, they show small average path length relative to their sizes, a typical feature of small-world networks. However, they decrease instead of growing when size is taken into account, unlike other complex networks. Different transitivity indices show mixed results. Average Watts-Strogatz clustering coefficient increases in larger cities much larger than expected by pure chance as it has been shown in other social networks. On the other hand, the fact that classic transitivity index decreases seem to exhibit a regime change with a decreasing relation with size and an unexpected growth in larger cities. Both transitivity indices, as a whole, could describe among those who are making new interactions as the city grows. All these results indicate that while tightly knit human communities seem to lose cohesion as they grow, such community properties may progressively disappear among the three to four largest urban centers in Chile where the coordination of complex functions requires each city dweller to reach out to a larger network of people and speak for longer periods of time as compared to smaller cities.

5. *Marina Toger; Itzhak Benenson; Sarit Weisburd*
The deterrence effect revisited: spatial analysis of the impact of police presence on probability of crime.

With growing urbanisation as well as upsurge in human population, increasing attention is being paid to so-called smart policing, where limited resources are deployed in an optimised fashion to achieve maximum visibility, shortest response times and, finally, minimise the crime. At the heart of smart policing, there is a need to analyse correlation between spatiotemporal patterns of the presence of police, and the occurrences of crime. While some literature showed that relocating police forces did not significantly impact crime occurrence, other researchers showed that concentrated police presence decreases probability of crime in these areas.

Recently available high-resolution spatial data on police presence and emergency calls to police enable revisiting this question using the new big-data analysis techniques. In this project, we analyse detailed GPS records of police vehicles together with crime locations time-stamped using 911 calls records in Dallas, Texas USA. We develop a statistical model of spatiotemporal dependence between the police vehicles and emergency calls and detect both spatial and temporal thresholds over which presence of law enforcement affects the probability of misconduct. The critical issue of significance of the revealed dependency is studied with the help of statistical simulation, based on the randomised datasets: Void of any interaction effect between police and crime and several kinds of possible deterrence. In this way we investigate the dependency of the frequency of crime, by the types of the incidents such as violent crimes, burglaries, public disturbances, etc.

Our approach captures the data in fine grain with exact time and location in order to detect effects that are lost in aggregation. Instead of grouping incidents by area, which cloaks differential effects in specific places within that unit, the aggregation of police-crime interactions based on recurrent sequential patterns and effects paints a nuanced picture of the complex impacts and specific possible strategies for optimisations.

8A - Politics and Demographics

1. *Celio Sierra-Paycha*
How National Urban Systems shape International Migration Systems: the case of Colombia

Thanks to national statistical data based on censuses and a century long tradition of researches (Berry 1964, Pred 1977, Pumain et al. 2015), the structures of national urban systems are well known. On the contrary, the topic of international migration fields (the distribution of a population born in a specific country across the world as defined by Hägerstrand in 1957) is barely studied. One reason for this discrepancy is the lack of homogenous statistical data covering the entire population. Except for some countries whose population registers can serve as support for such analyses, very few papers study the spatial distribution of international migration.

We want to use the Colombian case to open this research field. On the one hand, Colombia offers a very interesting study case since its national urban system developed in a "quadricephalic" way around four cities that concentrate more than a million of inhabitants in each city since the nineties: Bogota, Medellin, Cali, Barranquilla. Only in the past twenty years did Bogota, the capital, grow faster than the other three cities. On the other hand, Colombian international migration is characterized by an important out-migration distributed in three major countries: Venezuela since the sixties, the United States since the seventies and Spain since the nineties. Nowadays, the three named countries still concentrate more than 300 000 people born in Colombia whereas the countries that follow in this ranking (Ecuador, Great Britain, France, Italy) each comprise less than 50000 Colombian residents.

On the grounds of a multi-sited quantitative database using the 2005 Colombian census and Spanish demographic surveys, this paper questions the shape of the Colombian international migration field from the perspective of the internal organization of the urban system. Which parts of their country of birth do Colombians living in Spain, Venezuela and the U. S. come from? Our results show that each of the international out-migration destination matches with a specific area of Colombia that played an important role in structuring the growth of the local big city: for example migrants moving to Spain come more specifically from Cali and surroundings, Colombians living in Venezuela, more specifically from Barranquilla and nearby area, Colombian residents in the U.S mostly come from Medellin and nearby cities whereas the destinations of people born in Bogota are highly diversified.

To understand how migrants reproduced on an international scale the specific patterns of their internal distribution, the macroanalytical models such as the push and pull factors theory and the gravity models are not sufficient. The analysis on a meso-level reveals that personal networks and family play a much more decisive role than macro-economic factors or distance.

2. Nick Hood; Myles Gould; Jocelyn Evans; Paul Norman
Is your local area susceptible to the radical right? Differentiation UKIP support using an area based classification of electoral wards in England

As a party perceived to be part of the Radical Right populist party family in Europe (John and Margetts, 2009; Ford and Goodwin, 2014; Clarke et al, 2016), considerable attention has been given to the specific drivers of electoral success for the United Kingdom Independence Party (UKIP). Polling 26.6 percent of the vote in the 2014 European Election, and 12.6 percent in the 2015 General Election, the party has been described as appealing to 'left behind Britain' (Goodwin and Milazzo, 2015). This group has generally been seen as comprising dual electorates, combining discontented Eurosceptic Conservatives in the south of the country with working-class voters disenchanted with the Labour Party in the north. Recent elections results have also shown a prevalence of support along much of the East coast of the country. Much of the recent literature has focused on the party origins of support for UKIP, and debated its likely pools of support (Evans and Mellon, 2016; Ford and Goodwin, 2016; Mellon and Evans, 2016). However, much of this literature focuses on individual level effects of different variables on UKIP support or uses large spatial units (constituency/local authority) and in our opinion undervalues the ecological composition of local areas (in this case electoral ward).

This paper focuses on the socio-demographic conditions in English wards at the 2015 local elections and uses a range of indicators from the 2011 Census and other public data sources to characterise the socio-economic context of wards and, using the data reduction technique of k-means clustering, classifies areas by antecedents of support for the major political parties in England. This finer spatial analysis allows us to understand how differing local contexts may drive UKIP support (as a function of ward classes) and we

subsequently rank the favourability of electoral wards to UKIP support. We then look at the voting profiles of these classes, for all parties, but focus specifically on UKIP share of the vote to identify how the party performs across wards with different ecological characteristics. Lastly, we use the 2017 General Election constituencies in which UKIP fielded candidates to consider the extent to which the parties chose areas, in an election broadly expected to see a collapse of its support, close to the favourable classes identified by our model.

The classification finds specific spatial contexts in which UKIP struggled for votes at its 2015 peak but finds a more complex picture of the types of area in which the party achieved greater levels of support. Moreover, the classification is reassuring in its confirmation of the effects of a number of variables on UKIP support (particularly level of education) whilst it provides additional insights in to the effect of other variables on radical right support (notably age) which are found to be heavily influenced by specific spatial contexts at the electoral ward level in England.

3. Myles Gould; Nicholas Hood; Jocelyn Evans; Paul Norman
Introducing an European comparative multilevel study of 'radical right' support

Electoral support for the 'radical right' parties such as the French FN, the German AfD, the Dutch PVV and UKIP in Britain have received considerable attention in political science, particularly for those elections where they have been successful (e.g. for UKIP prior to the 2016 Referendum on leaving the EU). Previous research has shown that the principal motivations for supporting such radical right parties has historically been related to anti-immigrant sentiments and anti-Muslim attitudes. Such factors become important in peoples voting decisions in local and national contexts.

Comparative research on radical right parties in political science has focused mainly on national-level indicators and individual motivations when explaining variations in support for these parties. Whilst some research has used local data to look at how support varies within individual countries, there has been a notable absence of comparative research that formally and simultaneously examines: the regional and 'neighborhood' contexts, and individual determinants of radical right support. The interdisciplinary SCoRE (Sub-National Context and Radical Right Support in Europe) project is building a multilevel analysis for four countries: France, Germany, the Netherlands and the UK.

In this paper we report on the collation of available secondary political, demographic and socio-economic data from official sources at the regional and local levels. We summaries a number of challenges that have had to be overcome in harvesting and combining a common set of harmonized indicators for the different countries with different approaches and traditions for the collection and dissemination of official statistics. We also consider the decisions taken in selecting a common finest spatial scale and definition of neighborhood units for making cross-national comparisons.

We will also report on the second phase of the project which has involved the design and administration of a standardized social survey of party support and public opinion across the four countries. This has just resulted in the collection of an up-to-date set of demographic, attitudinal and behavioral information for individual's voters across the four countries and has been timed to fit their election cycles. For the UK, we will provide some initial descriptive analysis of the survey conducted just after the 2017 'snap general election'. We will also briefly outline future work involving multilevel comparative modelling of radical right support, to identify the relative role of contextual and individual/compositional determinants of factors of party support.

4. Stephen Clark; Michelle Morris; Nik Lomax

Estimating the UKs referendum on EU membership using e-petition data and machine learning algorithms

The United Kingdom's (UK) 2016 referendum on membership of the European Union (EU) is perhaps one of the most important electoral outcomes in the UK for over half a century, with the impact being felt both domestically and internationally. The political sentiment embodied in this outcome has challenged politicians, media commentators and academics alike. In particular many believe that it is important that local Members of Parliament take account of this sentiment in debates concerned with the UK exiting from the EU (BREXIT). Unfortunately for many areas of the UK this outcome is not known for Westminster Parliamentary Constituencies (WPC), rather it is known for the coarser geography of local authorities/counting areas (CA). This study complements existing research that attempts to estimate the leave/remain outcome for these WPCs. The research uses novel e-petition data collected by the UK Parliament's Petitions Committee and machine learning algorithms to predict the outcome for each WPC. The performance of each algorithm is compared and evaluated against both known outcomes and alternative estimates. The algorithm that is seen to perform best with testing data and produce results which correlate well to other estimates is a rule and instance-based regression modelling algorithm.

8B - Land use

1. Remi Lemoy; Geoffrey Caruso
Evidence for the Homothetic Scaling of Urban Forms

In this work we analyse the profile of land use and population density with respect to the distance to the city centre for large European cities. In addition to providing the radial population density and soil-sealing profiles for a large set of cities, we demonstrate a remarkable constancy of the profiles across city size.

Our analysis combines the 5m resolution GMES/Copernicus Urban Atlas 2006 land use database for 300 large European cities (population greater than 100.000 inhabitants) with the 1km resolution Geostat population grid. Population is allocated proportionally to surface and weighted by soil sealing and density classes of the Urban Atlas. We analyse the profile of each artificial land use and population with distance to the town hall.

In line with earlier literature, we confirm the strong monocentricity of European cities and the negative exponential curve for population density. Moreover, we find that land use profiles, in particular the share of housing and roads, scale along the two horizontal dimensions with the square root of city population, while population density profiles scale in three dimensions with the cube root of city population. In short, European cities of varying sizes are homothetic in terms of land use and population density, and these two phenomena scale respectively as a surface and a volume.

While earlier literature documented the scaling of average densities (total surface and population) with city size, we document the scaling of the whole radial distance profile with city size, thus liaising intra-urban radial analysis and systems of cities. In addition to providing a new empirical view of large European cities, our scaling offers a set of practical and coherent definitions of a city, independent of its population, from which we can re-question urban scaling laws and Zipf's law for cities.

In particular, we find that the distribution of European cities' sizes does not follow Zipf's law, which corresponds to an exponent -1 for the counter-cumulative distribution of sizes. We find rather an exponent of $-3/2$, which corresponds to older systems of cities.

2. Alexandre Ornon
A spatial multiscalar modelisation of urbanisation in the South-East of France

Spatial context:
Over the last decades the region Provence Alpes Côte d'Azur has been subjected to the most important rate of urban growth in France on account of the metropolitan polarisation of Marseille and Nice. As accessibility increases at a macro-scale, this entails a lengthening of work-home fluxes, and accordingly, a growth of sub-urbanisation. These mechanisms mainly concern the department of Var, located between Marseille and Nice.

Purpose:
The intent of this research is to grasp urban growth factors via spatial modeling. The aim is to explore these mechanisms in action by testing simulations on cellular automata (Voiron-Canicio and al. 2014) and finally to submit at different scales a prospective insight for 2030. The main issue is to design a method for interlocking different models produced at different scales. This modeling proposal is built on the articulation of four different sub-models structured by scalar interactions. Combining them allows to test and to comprehend with more accuracy the differences between each scalar process of urban growth.

Method:
The first sub-model simulates urban growth at a macro-scale inside the region Provence Alpes Côte d'Azur. The resulting simulations enable to pinpoint the main changing areas (i.e. the Var) in order to focus on a new model extent for a second phase. The second model includes more parameters such as an indicator of urban pressure and morphological potentials of development. After simulating urban development for 2030 at a higher resolution, the model extent is redefined accordingly.
Regarding the local scale, the modeling rules are identical except for an extra input of a protected area layer as well as a more landuse-oriented approach. The scope applies to the city-county and aims at simulating residential building development.
Finally, the results from the local scale model permit the determination of the last sub-model's extent, at a micro-scale (i.e. city scale). Centered on a city, the rules and the urban development processes are based on city planning schemes. For each step of modeling, a spatial analysis of spatial trends is undertaken before their translations into modeling rules. The calibration is carried out by using geostatistics (Dauphiné and Voiron-Canicio 1988) and mathematical morphology(Voiron-Canicio 1995). In a third phase, a thousand simulations are performed on the model by keeping the same parameters to obtain the main changing zones.

Conclusion:
With this modeling approach, mechanisms of the urban growth are distinguished on the one hand by the scale / resolution and on the other hand by the increasing of complexity of the sub-model rules. As a result, the location of the main changing spaces is more and more accurate, zooming in from quarter-scaled areas to buildings.

References:
Dauphiné, André, et Christine Voiron-Canicio. 1988. Variogrammes et structures spatiales. Reclus modes d'emploi 12. Reclus.
Voiron-Canicio, Christine. 1995. Analyse spatiale et analyse d'images par la morphologie mathématique. Collection Espaces modes d'emploi. GIP Reclus.
Voiron-Canicio, Christine, Fabrice Decoupigny, Sophie Liziard, Alexandre Ornon, Delphine Roussel, et Romain Sery. 2014. « PLUMES : Pression Littorale Urbaine : Modélisation, Environnement, Simulation ». OHM Littoral Mediterranéen, Labex DRIIHM.

3. *Emilie Lerond; Olivier Klein; Jean-Philippe Antoni*

Data transformation for land-use / transport interactions exploration

Introduction
Models in geography have been developed with the improvement of hardware and softwares. These allow the computation of multidimensional, disaggregated and voluminous data as mobility geosimulation results, accordingly an improvement for mobility behavior analysis. To make this kind of analysis better, disaggregated data like agent-based and mobility geosimulation are more and more used. Nevertheless their quantity and structures can be hard to handle and exploring these data is required to understand mobility and its interactions with land-use. This paper focuses on data structuration to compare spatial distributions.

Data
The dataset is generated by MobiSim, an agent-based mobility simulation model (Antoni et al.,2016). It describes the daily mobility of 180,000 individuals in the Great Besançon (France) during 24 hours, i.e 15.5 billion of spatio-temporal positions.

Methods
Spatial datasets are classically considered as points (mobility traces), lines (transportation network) or polygons (buldings) in Geographical Information Systems. In order to make comparable these three different types of spatial data, there are transformed.
First, data are aggregated in separate grids of same form and same resolution: points and polygons are counted in aggregation units, line are snapped to unit centroids and number of lines are counted. So each type of spatial data is structured in separate, but equivalent, grids.
Then, elements in grids are transformed in scattered points pattern according to centroids of aggregation units. Analysis of these scattered points patterns allows comparisons on spatial distributions and to pinpoint links and interactions within elements.
Finally, from scattered points patterns, two kinds of analysis are processed. Analysis of each data in a separate way, to understand its organization: e.g. is there a link between number of movement and distance to urban center of study area ? Second kind of analysis between data allows to understand their interactions: e.g. can some interactions between mobility and land-use be revealed and highlighted, in statistical and visual ways ?

Conclusion
This method consists in a first step to explore massive mobility dataset, due to data spatial transformation. It makes data comparable and allows a statistical and visual integration of datasets as land-use and mobility. This integration enables to new analysis tools and new hypotheses on land-use and mobility interactions.

4. Nikita A. Sinitsyn

Cellular automata for suburbanization modelling: the case of Belgorod

Belgorod is not a big regional centre (253,000) in the south of Russia. The local governor has provided effective migration policy since 1992. Belgorod is one of the most appealing cities to rather wealthy pensioners from northern Russian regions. The growth of demand led to high housing prices in multi-storey buildings. So the share of one-storeyed buildings in annual construction within Belgorod agglomeration increased from 12 % (1992) to 77 % (2016).
Unique circumstances make Belgorod region the first agglomeration with large suburban area in the country. This case is really a great chance to understand the main patterns of Russian suburbanization. Suburbanization is among the most probable variants of housing market development in Russia – there is no lack of land. The result of settlement system shrinking is concentration of population in the biggest

agglomerations with population over 500,000. Once upon a time, one-storeyed house will be cheaper, than the same flat in multi-storey building.

When the time is due, the model will help urban planners to predict spatial development of suburbanization in Russian agglomerations.

Cellular automata simulates spatial development of suburban areas from 1992 to 2014.

Each iteration consists of three steps: calculation of transition potential, cutting fixed cells from potential raster and selection of new generation of cells.

Six factors of suburban appearance were defined.

Four quantitative factors are characterized by the distances from some objects: city centre, main roads, sewage treatment plants and main sewer pipes, multi-story buildings and previous suburban generations.

Two qualitative factors characterize the content of certain place: the pollution areas of plants with high smoke stacks and a kind of vacant cells – apple gardens are less attractive than empty fields.

The result of modelling looks like real suburban areas at every iteration, not only at last. The main advantages of this model are the absence of calibration and simplicity.