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About

(/university/colleges/les/research-gallery/lee-chapman.aspx) Dr Lee Chapman's research interests are at the interface of climatology and engineering investigating *the impact of weather and climate on the built environment*; an important research area given the ever-increasing concentration (and vulnerability) of the population and critical infrastructure in urban areas. This covers a range of topics and sub-disciplines including infrastructure meteorology, urban climatology and climate change adaptation. Knowledge transfer and business engagement are at the heart of this research agenda and he continues to work extensively with industry to ensure maximum impact from ongoing research activities.

Qualifications

- BSc Geography (University of Sheffield, 1998)
- PhD Geography (University of Birmingham, 2002)
- PG Cert in Learning & Teaching (University of Birmingham, 2009)

Biography

Dr Lee Chapman completed his PhD entitled "A Blueprint for 21st Century Road Ice Prediction" here in Birmingham. The aim of the project was to assimilate new technologies to develop the next generation of road weather prediction models (Route Based Forecasting). The main application was to accurately forecast road surface temperatures enabling optimal salt usage by local councils. The project involved the development of GIS models which utilised new survey techniques based upon GPS measurements and digital image processing.

A university spin-out company called Entice Technology Ltd was set up using funding received from the NERC SBRI scheme (£125k) to fund further technological development, protection of intellectual property by the filing of patents and commercialisation of the work carried out for the PhD. The business was sold in 2006 to Weather Services International Ltd. Dr Chapman is still actively involved in research and business engagement with respect to winter road maintenance. He is presently the President of the Standing International Road Weather Commission (SIRWEC).

In 2010, after holding a Roberts Research Fellowship for 5 years, Lee Chapman was promoted to a Senior Lectureship in Applied Meteorology and Climatology and since 2013, has held a Readership in Climate Resilience. He was awarded the 2013 RGS Cuthbert Peek award for advancing knowledge of urban climatology through GIS and remote sensing.

Teaching

Dr Lee Chapman is a Fellow of the Higher Education Academy and has a significant teaching profile which spans several modules and programmes of study:

- 105: Tutorials, IT Skills & Fieldwork (Personal Tutor)
- 203B: Geomatics for Geographers
- M4: Foundation Maths
- M9: Atmospheric Observations
- Dissertation Support (BSc / MSc)

The teaching methods and assessment strategies used on these modules were informed by studying for a PGCert in Learning and Teaching which Dr Chapman completed in 2009. He was nominated for a prize in Level 1 of the course and won a prize for Level 2 where he had his teaching project published:

Chapman, L. (2010) Dealing with maths anxiety: How do you teach mathematics in a geography department? Journal of Geography in Higher Education 34:205-213.

Postgraduate supervision

Dr. Chapman currently supervises six postgraduate students:

- Juliana Antunes De Azevedo: Impact of urban heat on current and future energy demand (funded by Science Without Borders)
- Tatiana Prieto-Lopez: Impact of urban heat islands on the life expectancy of distribution transformers (partly funded by E-ON)
- Richard Bassett: Quantifying the influence of wind advection on urban heat islands for an improvement of a climate change adaption tool (funded by NERC with Birmingham City Council as a CASE partner)
- Daniel Murrant: Quantifying the impact of future water energy nexus constraints on the UK non-nuclear thermoelectric power station fleet both in terms of cost and

technology (funded by the Midlands Energy Consortium with Energy Technologies Institute as a CASE partner)

- Duy Phan Nhut: Planning resilient transport systems in relation to flooding and other hazards (funded by Vietnamese International Education Development)
- Thomas Bennett: Road temperature modelling and dynamic gritter routing. (based at Aston University with supervisors Dan Cornford and Lucy Bastin, funded by EPSRC with Amey as CASE partner)

Potential students should contact Dr. Chapman directly.

Research

Research groups

- **Environmental health sciences (/research/activity/environmental-health/index.aspx)**
- Climate and atmosphere

Current Projects:

Solving the Adhesion Riddle (PI: Funded by EPSRC and the Railway Safety and Standards Board: £104k)

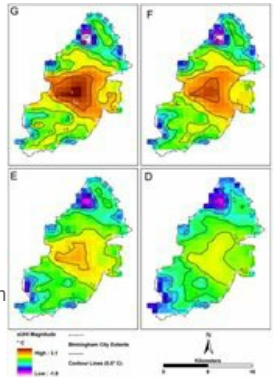
This project is conducting a feasibility study into how high resolution sensor networks and hemispherical imagery could potentially be used to reduce the perennial problem of leaves on the line. Poor traction and braking from leaf fall in the autumn currently cause severe problems to the railway system. However, these issues are not confined to autumn alone as the condensation of water droplets on rail heads during warmer months, as well as other contaminants can also alter the interface between the wheel and the rail and cause poor braking. The project will explore the potential of an Internet of Things based methodology to measure moisture on our railways at an unprecedented scale. A tied studentship will also look at innovative means to monitor and quantify leaf fall during Autumn for inclusion in models currently run by project partners, the Met Office.

Wintersense: Demonstrating the Potential of the Internet of Things (IoT) in Winter Road Maintenance (PI: Funded by EPSRC: £208k)

IoT literally means 'things' (e.g. sensors and other smart devices) which are connected to the internet. This may seem insignificant, but 'things' represent a new, and increasingly, critical infrastructure requiring a dedicated technological ecosystem. Indeed, since 2008, the number of 'things' has outnumbered users online. The WINTERSENSE project was co-created with Amey who manage the PFI (Private Finance Initiative) contract for Birmingham City Council and will see a deployment of a new generation of low cost, internet enabled, road surface temperature sensors embedded within an Internet of Things ecosystem. For the first time, this approach will provide a high resolution monitoring and verification solution for route based forecasts commonly used by decision makers to determine where and when to salt the roads in winter. It is hoped that this project will further reinforce user-confidence in such forecasts, in turn enabling increasingly cost effective 'smart gritting' operations in the sector.

HiTemp (PI: Funded by NERC Networks of Sensors: £610k)

(/Images/College-LES-only/GEES/staff-research/chapman-surface-temps.jpg)



The Urban Heat Island (UHI) is a direct consequence of anthropogenic influences on our local climate. Many studies have been devoted to the study of UHI extent and magnitude, as well as the impacts increased urban temperatures have on meteorology, climatology, human health and society. Although the UHI phenomenon is well documented and studies have increased our understanding, the basic measurement of temperatures across urban areas remains very limited. Birmingham is the UK's second most populous city, with a population in excess of 1 million people and a well defined UHI. However, Birmingham has only two climate stations which when linked with the complex heterogeneous urban morphology results in extremely poor data coverage.

The overall aim of HiTemp is to provide a demonstration sensor network designed to measure air temperature across the Birmingham conurbation. Birmingham has been chosen for this study partly due to its size as the UK's second city but also due to the fact that it is politically homogenous and requires only the co-operation of a single local authority. HiTemp is working towards instrumenting Birmingham via nested arrays of sensors including over 30 weather stations plus an additional 200+ air temperature sites located on a citywide wi-fi network. The end result will be the Birmingham Urban Climate Laboratory.

LivingRail (Co-I: Funded by FP7: £109k)

This study will develop scenarios on the state of living style, cultures, mobility and economic activities in Europe by 2050 and explore a vision on the future role of the environmentally friendly, electrified railways within them. The scenarios and visions are detailed by trends in society, policy, economics, spatial planning, urban development, technology and transport sector operations to gain profound understanding of the sector interrelations. With the help of these detailed assessments the project will eventually elaborate a pathway or "railmap" to approach the 2050 vision from today's situation. The funding is particularly timely due to the recent £9bn railway investment announced by coalition in British railways which will see a number of rail-lines electrified over the next decade.

Other Recent Projects:

Internet Of Things Convergence (Co-I, Funded by Technology Strategy Board: £140k)

In 2013, we were funded to partcipate in two 12 month demonstrator grants under the IoT call. The first project, Smart Streets, was worth £70k and explored the utility of such devices to be used in real world applications such as winter road maintenance and gully cleaning (partners include: Amey, Carillion, Balfour Beatty, InTouch). The second project, DISTANCE (Demonstrating the Internet of School Things – A National Collaborative Experience), also worth £70k, explored the ability for schools to measure and share data by creating an information hub in the cloud using an open-source and infinitely scalable application platform for themes such as transport, energy, weather and health. (Partners include: Intel, Cosm ,the OU, the geography collective and ScienceScope).

FUTURENET (Co-I: Funded by EPSRC: £1.4m)

This project aims to assess the future resilience of the UK transport network by taking into account the likely technology and infrastructure changes, as well as changes in climate and extreme weather events. Future Resilient Transport Networks (FUTURENET) is a four year research project, jointly funded by the Engineering and Physical Research Council and the Economic and Social Research Council as a part of the *"Adaptation and Resilience to a Changing Climate"* programme, which aims to provide such a vision and tools to assess and plan for the resilience of transport systems in future.

FUTURENET is led by the University of Birmingham with partners from Loughborough and Nottingham Universities, HR Wallingford, the British Geological Survey, and TRL Limited. The project actively involves a wider stakeholder group which includes Network Rail, Highways Agency, the Institution of Mechanical Engineers, and consultants WSP.

Current discussion about transport and climate change focuses on the impact of transport on climate change. FUTURENET recognises that climate change also has an impact on transport, and can be addressed as an engineering dimension derived from the interaction between climate design, weather events and the physical network, and a socio-economic dimension derived from the interaction between weather and climate and the patterns of transport demand. FUTURENET integrates both in assessing the future resilience of the UK transport system. In doing so, it "joins up" traditionally separated agendas and addresses the inter-sectoral consistency of planning assumptions. While it is impossible to accurately predict exactly what will happen in the future, it is possible to model a range of plausible scenarios both in transport infrastructure and climate to address the concern for resilience.

The overall aim of FUTURENET is to answer the questions: what will be the nature of the UK transport system in 2050, both in terms of its physical characteristics and its usage, and what will be the shape of the transport network in 2050 that will be most resilient to climate change?

Sustainable Urban Meteorological Networks (SUMNs): Managing the legacy of the Birmingham Urban Climate Laboratory (PI, Funded by NERC: £13k)

This short scoping project investigates ways in which the legacy of the Birmingham Urban Climate Laboratory (HiTemp) will be managed. The study will identify prospective end-users and applications (businesses, industrial, service sector, scientific, public, educational) of the HiTemp project in Birmingham. The information will then be assimilated to characterise a sustainable Urban Meteorological Network in terms of size (i.e. number of sites), data quality / assurance and associated ongoing costs. Ultimately, this project will identify the way forward for financially sustaining an urban meteorological network long term and, in particular, what business cases can be made.

Knowledge Transfer Partnership: E-ON Central Networks (PI: Funded by Technology Strategy Board & NERC: £120k)

A Knowledge Transfer Partnership between the University of Birmingham and E-ON, Central Networks evaluated the impact of urban heat islands and climate change on the aging rate of transformers in Birmingham. There are currently 2000 transformers in the Birmingham area, many of which are now over 40 years old; hence replacement is now becoming an important issue. For this to be done successfully, the life cycles of existing transformers requires quantification taking into account various scenarios relating to climate change and urban heat island effects. This project sinvestigated the relationship between weather conditions and asset temperatures, using these relationships to make projections for various climate scenarios so that asset life cycles could be approximated.

Cross Disciplinary Feasibility Account (Co-I: Funded by EPSRC: £200k)

This project investigated improving local resilience through innovation. A series of stakeholder workshops and multi-disciplinary viewpoint papers were produced to ascertain the potential of 'bottom-up' approaches in improving our local infrastructure.

Other activities

- Reviews editor and member of editorial board for RMetS journal Meteorological Applications
- Associate editor of Transport Behavior and Society
- President of the Standing International Road Weather Commission
- Member of GEES Executive Committee
- Head of Climate & Atmospheric Research Sub-Group
- GEES representative for Knowledge Transfer
- Member of the NERC Peer Review College

Publications

Hooper, E., Chapman, L. & Quinn, A.D. (In Press) The impact of precipitation on speed-flow relationships on a UK transport corridor. *Theoretical and Applied Climatology*

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