Impact of urban heat and climate change on the Birmingham transport network.

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This studentship will focus on transport infrastructure and will aim to downscale the findings of the recent FUTURENET project to the neighbourhood scale. FUTURENET has moved academic discussion away from the mitigation of climate change in the transport sector (e.g. Chapman, 2007) towards addressing the potential impacts of climate change on the transport network (Table 1). FUTURENET utilised a multidisciplinary approach to the problem considering the future resilience of the transport network in terms of both hard infrastructure and usage via socio-economic scenarios at a national scale (i.e. Jaroszweski *et al*, 2010). In order to make the project manageable, the team has focussed efforts on a single transport corridor (London-Glasgow) with a view that the methodology would then be applicable nationwide to any transport corridor. However, one area which still needs to be developed is how applicable such methodologies are at the neighbourhood scale. This studentship will apply the findings of FUTURENET on the Birmingham transport network. The student will work with Network Rail and Birmingham City Council to identify local climate impacts on the transport network. Due to other ongoing research projects (i.e. the Birmingham Urban Climate Laboratory, the focus of this particular project may well be on the impacts and opportunities of urban heat (e.g. Table below: railway buckling, low adhesion, thermal comfort, road rutting, potholes, winter road maintenance etc), however, all climate effects are open for study.

An interdisciplinary approach will be taken, investigating both impacts on hard infrastructure as well as modelling future demand and travel behaviour under future climates. This will include utilising models of the failure modes of transport systems, and identifying / testing thresholds for the effects of climate on transport system. These models will then be evaluated to infer future climate impacts by means of a number of climate (i.e. the UKCP09 weather generator) and socio economic scenarios. There will be a considerable challenge in applying this approach at the neighbourhood scale, simply due to the amount of passenger choice in terms of alternative modes / routes available to travellers.

Increased numbers of hot days	1. Increased thermal loading on road pavements a. Melting tarmac b. Roadway buckling c. Expansion/buckling of bridges d. Increased numbers of tyre blow-outs 2. Increased railway buckling 3. Increased heat exhaustion of maintenance and operations staff 4. Effects of higher density altitudes on aviation a. Reduced engine combustion efficiency b. Increased runway lengths required
Decreased numbers of cold days	1. Reduced winter maintenance costs for road and rail 2. Improved working conditions for personnel in cold environments 3. Permafrost problems: a. Unable to rely on 'frozen roads' b. Infrastructure problems caused due to settlement when permafrost thaws c. Increased subsidence and landslides on slopes and embankments 4. Positive effects on marine transportation: a. Less de-icing required and freezing fog b. Less icebreaking required c. Potential opening of new sea passages in polar regions
Increased heavy precipitation	1. Road submersion and underpass flooding 2. Increased landslides and undercutting 3. Poor visibility 4. Exceedance of existing 100 year flood
Seasonal changes	1. Longer summers/shorter winters will mean changes in timing of a. Leaf-fall for railways b. Winter maintenance regimes c. Shift in ice/snow belts 2. Reduction in frozen precipitation–significant improvements in road safety
Drought	1. Navigation problems on inland waterways
Sea level change	1. Locations of ports may be inappropriate 2. Other infrastructure–many airports are built 10 m> of sea level 3. Localised problems, e.g. storm surges
Extreme events	1. Increased numbers of tropical storms? 2. Increased lightning effects on aviation No clear projections are available for wind

Suggested Reading

Chapman, L., *Azevedo, J.A. & *Prieto-Lopez, T. (2013) Urban heat and critical infrastructure networks: a viewpoint. *Urban Climate* **3**:7-12

Rogers, C.D.F., Bouch, C., Williams, S., Barber, A.R.G., Baker, C.J., Bryson, J.R., Chapman, D.N., Chapman, L., Coaffee, J. Jefferson, I. & Quinn A.D. (2012) Resistance and Resilience – Paradigms for Critical Local Infrastructure. *Proceedings of the ICE: Municipal Engineer* **165**:73-83

Jaroszweski, D., Chapman, L. & Petts, J. (2010) Assessing the potential impact of climate change on transportation: The need for an interdisciplinary approach. *Journal of Transport Geography* **18**:331-335

Dobney, K., Baker, C.J., Chapman, L. & Quinn, A.D. (2010) The future cost to the UK's railway network of heat related delays and buckles. *Proceedings of the Institution of Mechanical Engineers, Part F, Journal of Rail and Rapid Transit* **224**:25-34.

Applicants should apply via http://www.birmingham.ac.uk/postgraduate/courses/research/gees/environmental-health-risk-mgt.aspx where they should click on 'Apply now' and choose the option 'PhD in Department of Division of Environmental Health and Risk Management' and give the PhD title in the 'Funding details' section of the online application.