

Beyond emissions:

Scientific challenges in understanding cities and climate change

richard.dawson@newcastle.ac.uk

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With thanks to

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Why focus on cities?

- **Urban areas are concentrations of climate vulnerability as well as being major greenhouse gas emitters**
 - >50% global population and rising
 - 60-80% global GHG emissions
 - *BUT* this makes them our greatest opportunity!
- **Development decisions we make *today* will alter our vulnerability to climate change and our emissions profiles for *many years* to come**
- **Cities are increasingly important actors in setting the climate agenda (C20/40, Clinton initiative, ICLEI, Climate Alliance *etc.*)**

Cities as complex, highly interconnected systems

Urbanisation and Globalisation



Disease and terrorism

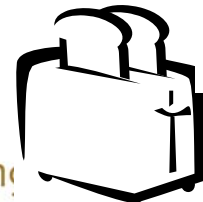


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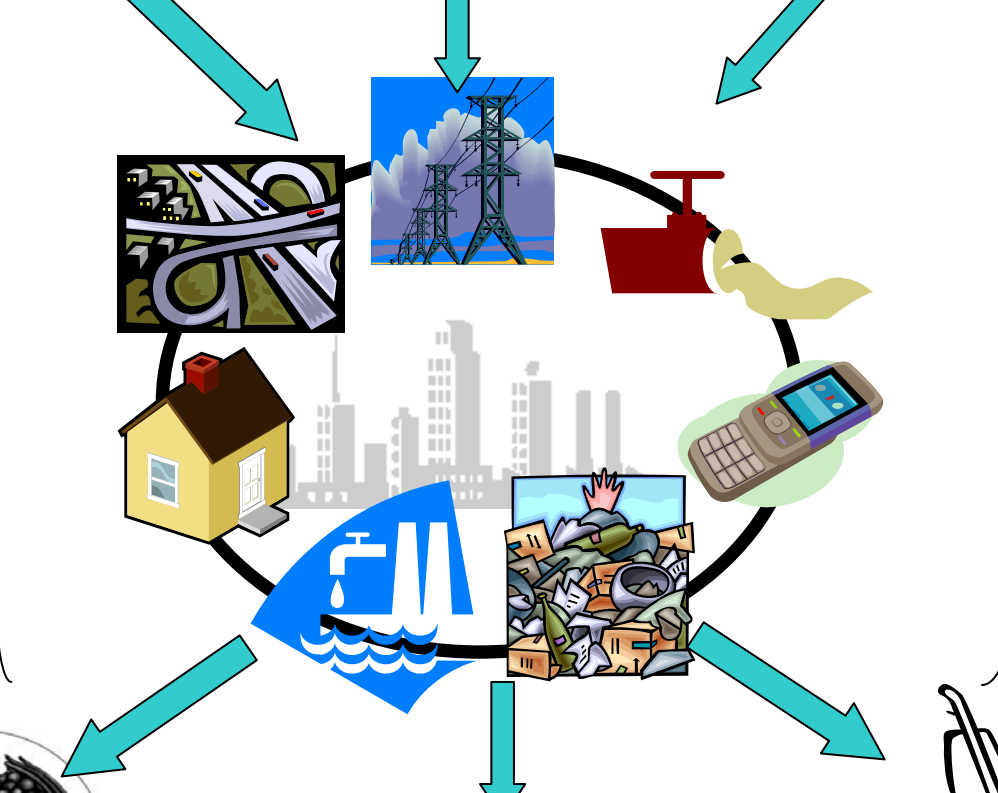
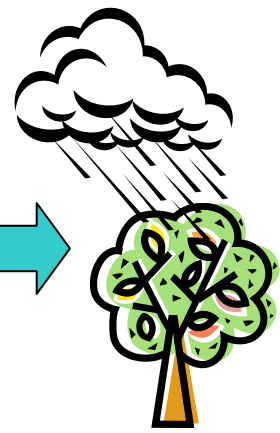
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Climate and environmental Change



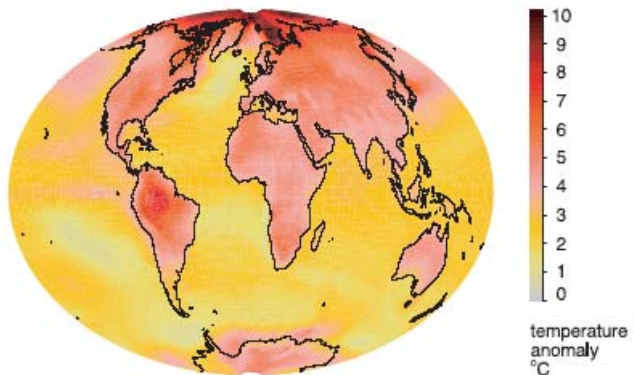
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Maladaptations and tradeoffs in urban management

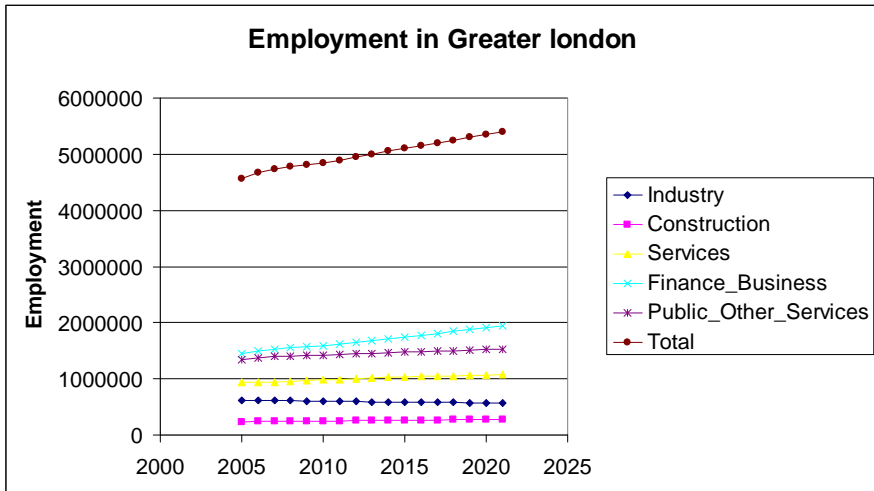
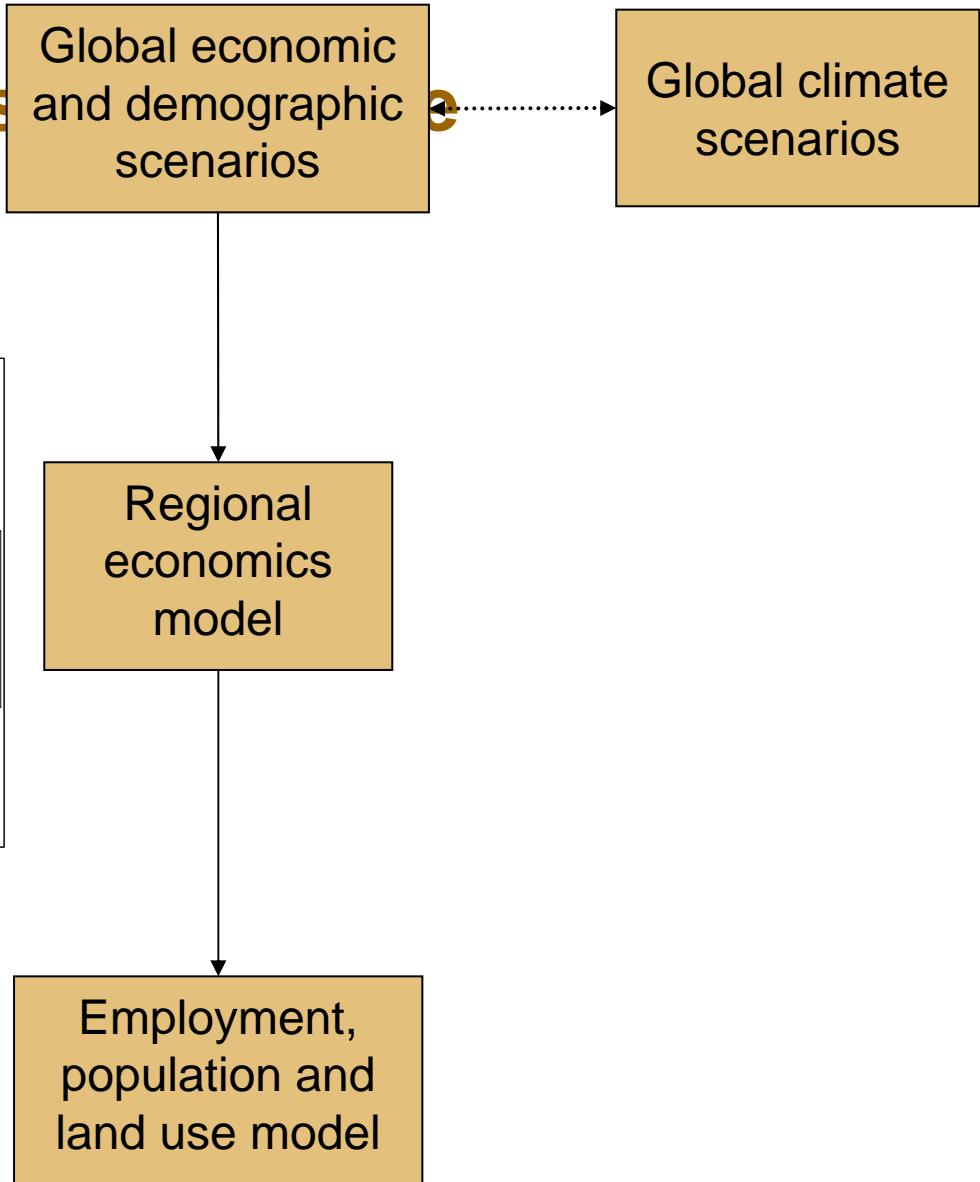
- Responses to climatic/environmental change in the urban area can have unwanted impacts within or outside the city on:
 - other climate change adaptations and mitigation activities;
 - environmental objectives;
 - economic objectives;
 - human wellbeing;
 - future flexibility to respond.

Response	Potential benefit	Potential negative impact
<i>Air conditioning</i>	Reduce heat stress	Increase emissions
<i>Densification of cities</i>	Reduce public transport emissions	Increase heat island intensity
<i>Desalination plants</i>	Secure water supply	Increase emissions
<i>Biofuels</i>	Reduce GHG emissions	Food security; deforestation; NOx emissions
<i>Catalytic convertors</i>	Improve air quality	Large scale mining
<i>Cavity wall insulation</i>	Reduce GHG emissions	Increase flood damages
<i>Flood defences</i>	Reduce flood frequency	Encourage more development (positive feedbacks)

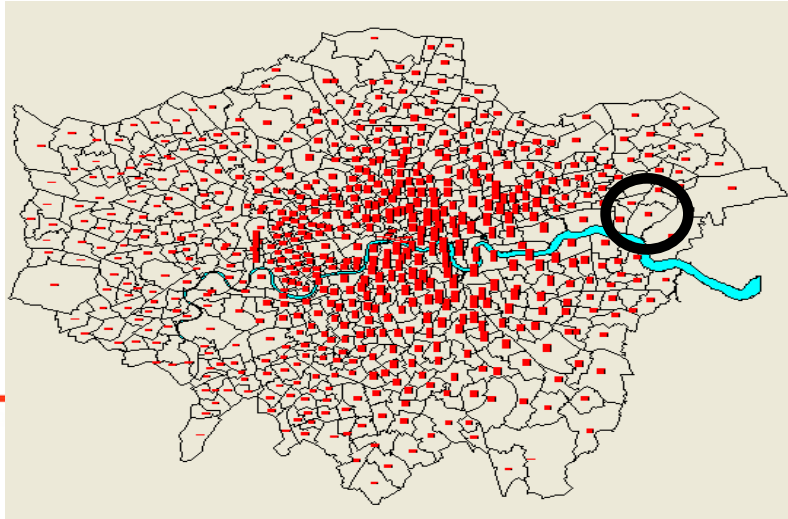
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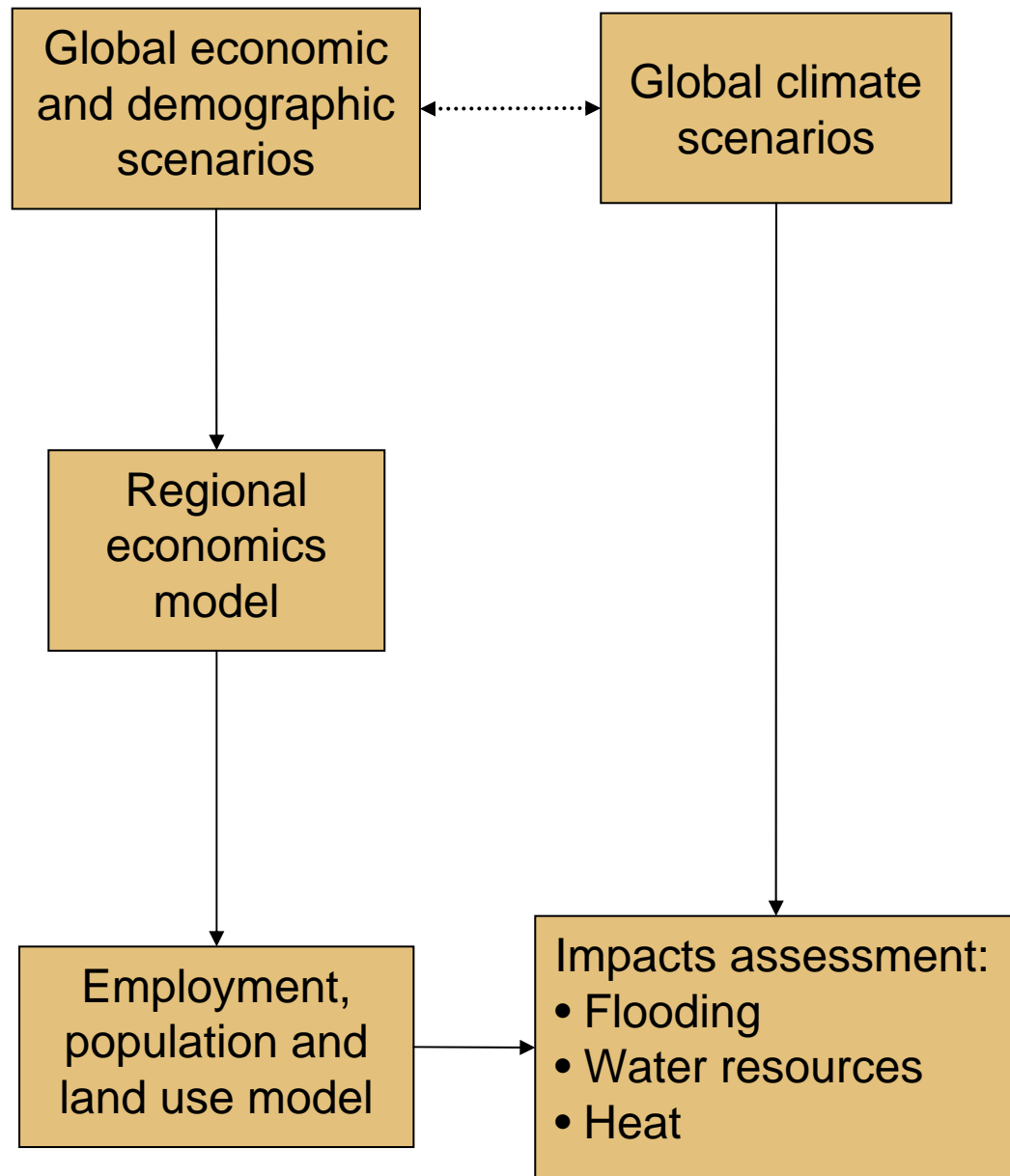
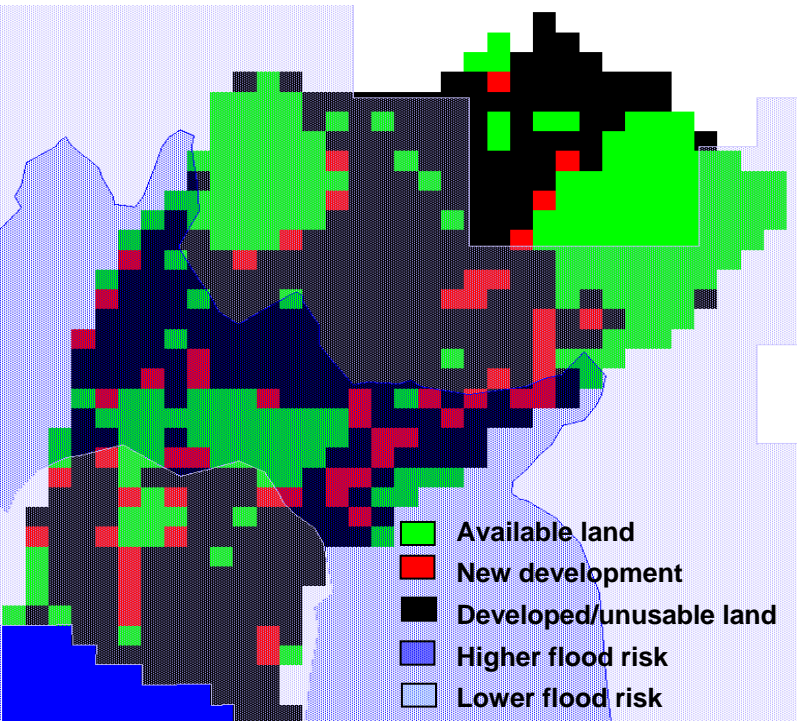


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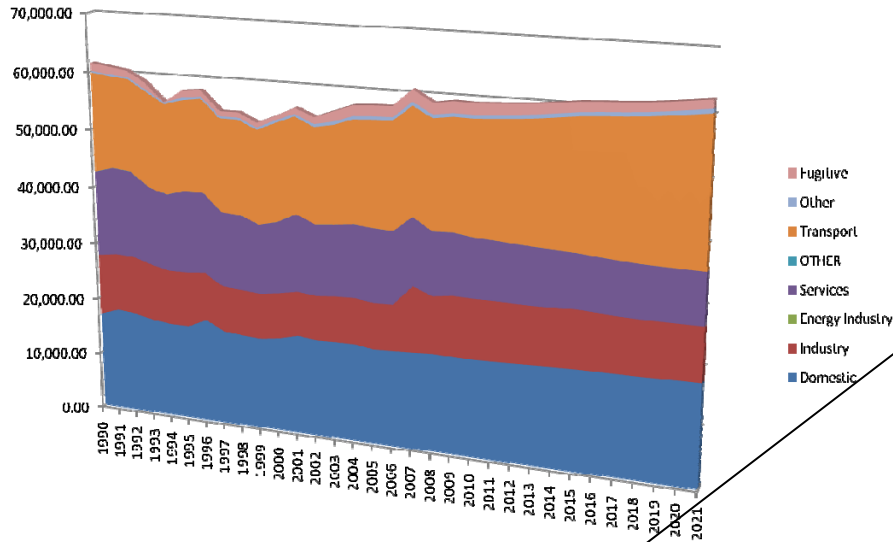
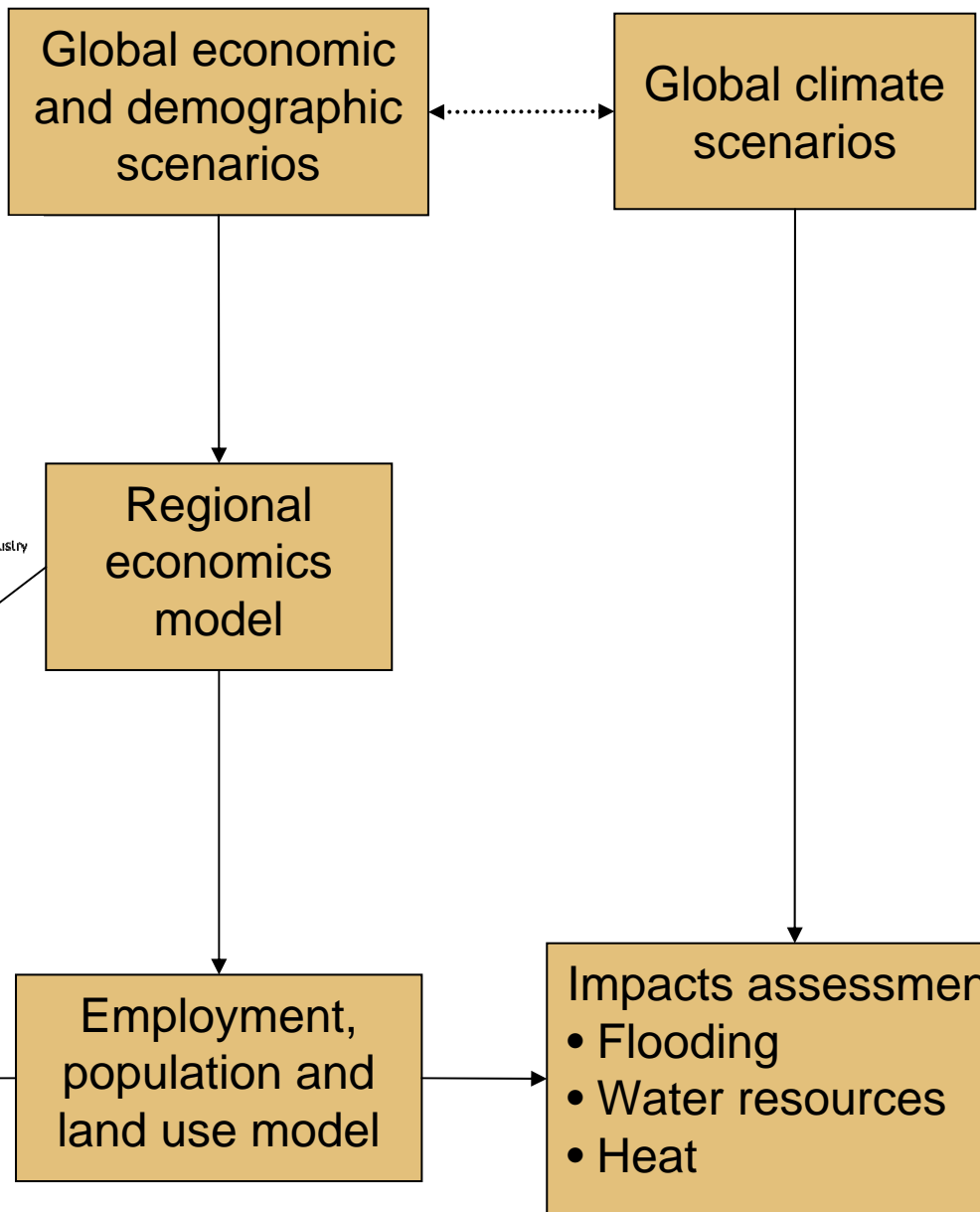


for climate change research

The assessment system



The assessment system



Emissions accounting:

- Energy
- Personal travel
- Freight transport

Employment, population and land use model

Impacts assessment:

- Flooding
- Water resources
- Heat

The assessment system

MAYOR OF LONDON



Global economic and demographic scenarios

Global climate scenarios

Regional economics model



Emissions accounting:
• Energy
• Personal travel
• Freight transport

Employment, population and land use model

Impacts assessment:
• Flooding
• Water resources
• Heat

Testing of policy options

Tyndall^o Centre
for Climate Change Research



Summary of Tyndall Cities programme

In order to address the question *“how can cities grow whilst reducing vulnerability to climate impacts and greenhouse gas emissions”*

We are developing a city-scale integrated assessment that:

- Address emissions, impacts and adaptation
- Works on the timescales of major planning and infrastructure decisions *i.e.* up to 2100
- Is based upon coherent national and regional economic, demographic and climate scenarios
- Is coupled with spatially explicit simulations of land use in order to understand key vulnerabilities (e.g. flood risk) and the effects of spatial planning decisions
- Includes the functioning of engineering infrastructure systems in a physically realistic way
- Is set within an appropriate uncertainty framework, including regional climate uncertainties

Research challenges

- Monitoring: towards a sensed city
- Modelling physical processes, urban dynamics and climate interactions
 - Multiple systems: energy, water, waste, food, materials, biodiversity, transport etc.
 - crossing scales
 - systemic effects
 - form, function and resource usage
- Understanding and modelling feedbacks
 - within and outside city borders;
 - from adaptation/mitigation responses;
 - climate shocks;
 - relationship with urban (micro)economy.
- Integrating technologies
 - software;
 - uncertainty cascade and probabilistic outputs;
 - risk analysis.
- Visualisation; engagement; education
- Governance and management
 - planning;
 - decision-support;
 - tradeoffs and multi-stakeholder management;
 - resilience and limits to adaptation.

Key messages

- Urban areas are concentrations of climate vulnerability as well as being major greenhouse gas emitters *BUT* consequently they are also our greatest opportunity
- Urban areas need to be studied in the context of national and global socio-economic and climate changes - but with due consideration of local factors
- Engineers and planners are currently generally aware of need to develop sustainable solutions to climate impacts *but* often lack necessary tools
- A portfolio of measures is required to deliver effective management of urban areas in the long term
- Look beyond the immediate locality and timescale: today (and tomorrow's) decisions will alter our vulnerability and emissions profiles for years to come
- Innovative approaches to adaptation and mitigation can be developed by evidence-based *integrated assessment* of urban systems

to paraphrase Charles Darwin:

...it is not the strongest of the cities that will survive, but rather the ones most responsive to change.

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richard.dawson@newcastle.ac.uk

