

## Beyond emissions:

# Scientific challenges in understanding cities and climate change

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*With thanks to*

*Jim Hall, Claire Walsh, Ali Ford, Stuart Barr (Newcastle)*

*Mike Batty, Steve Evans (UCL); Jonathan Kohler (Cambridge); Seb Carney (Manchester)*

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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

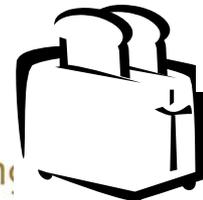


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Research



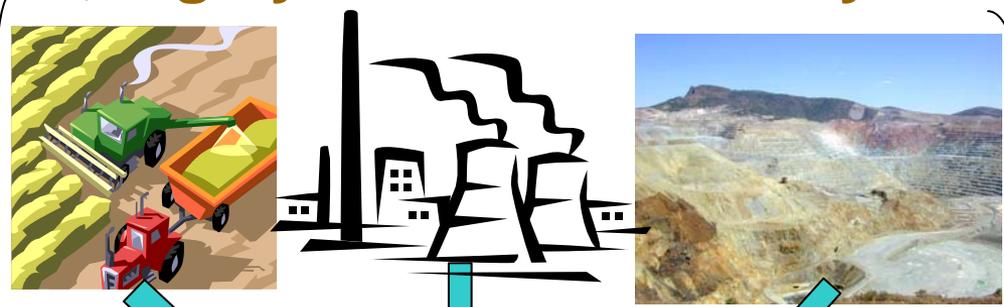
Engineering



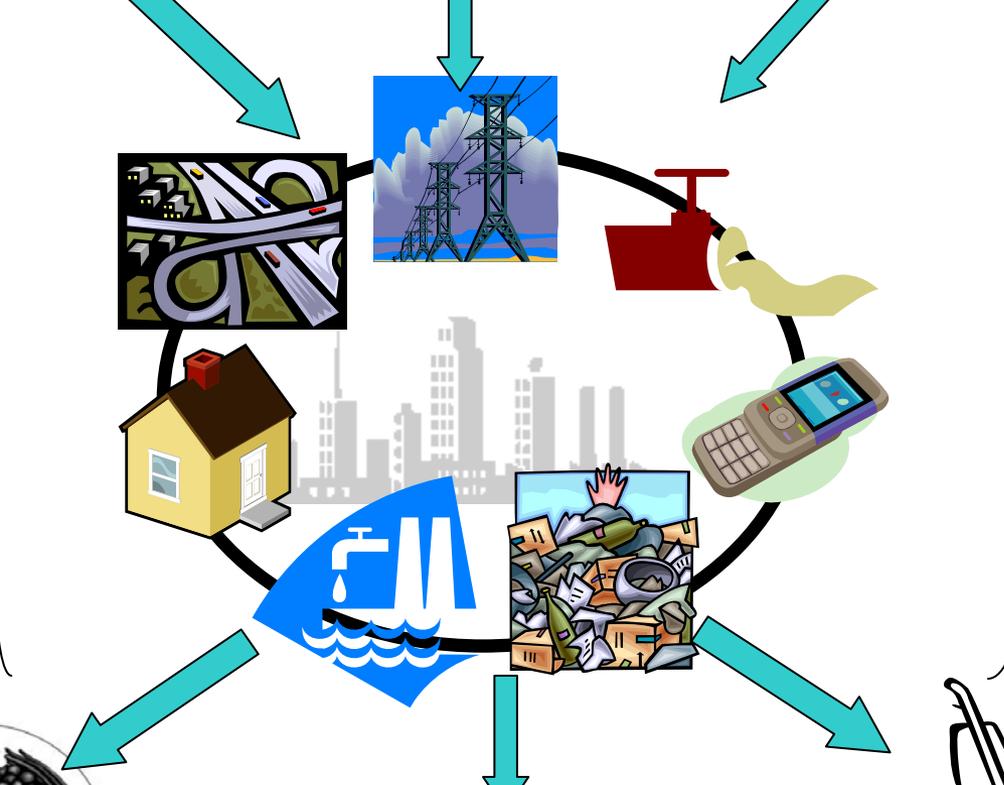
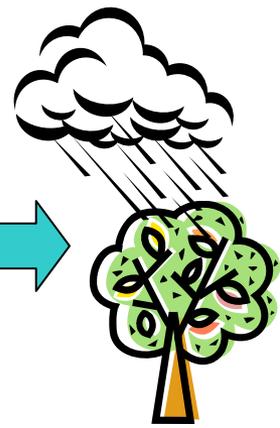
Sciences



Newcastle University



Climate and environmental Change

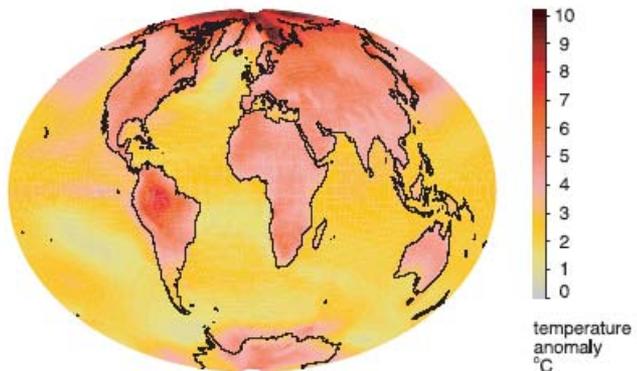


# Maladaptations and tradeoffs in urban management

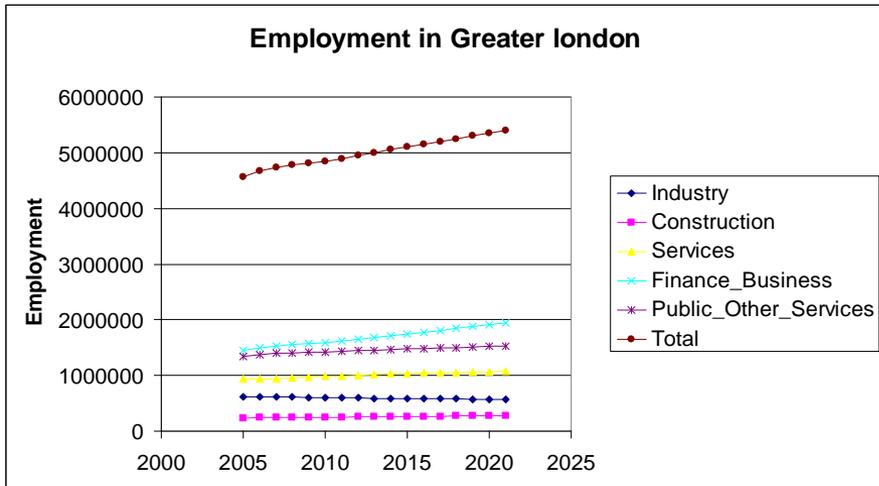
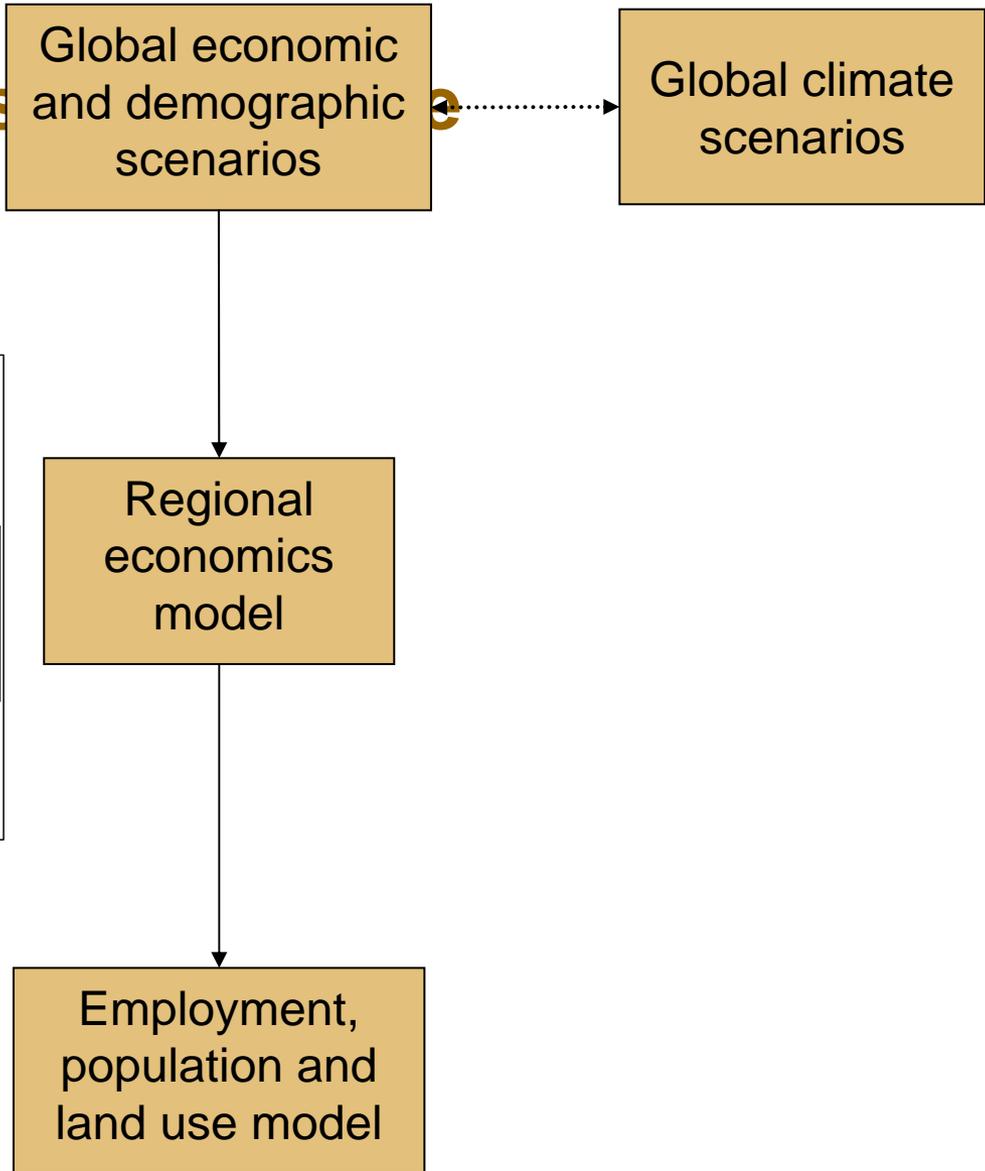
- Responses to climatic/environmental change in the urban area can have unwanted impacts within or outside the city on:
  - other climate change adaptations and mitigation activities;
  - environmental objectives;
  - economic objectives;
  - human wellbeing;
  - future flexibility to respond.

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)

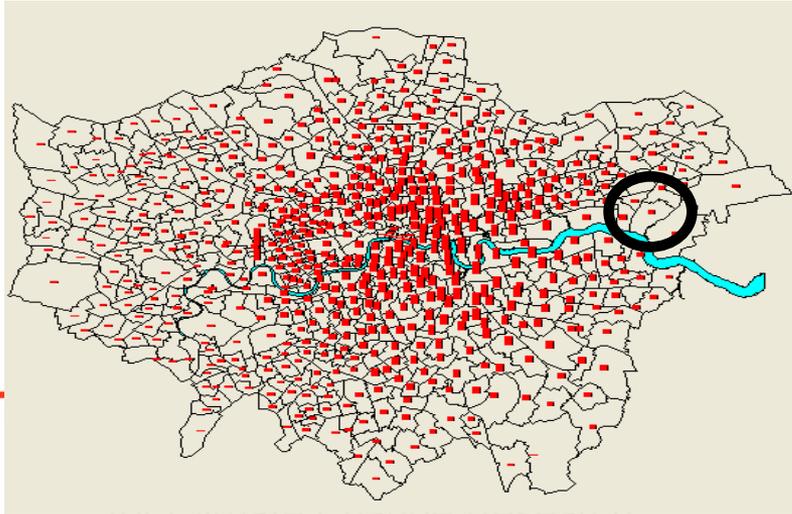
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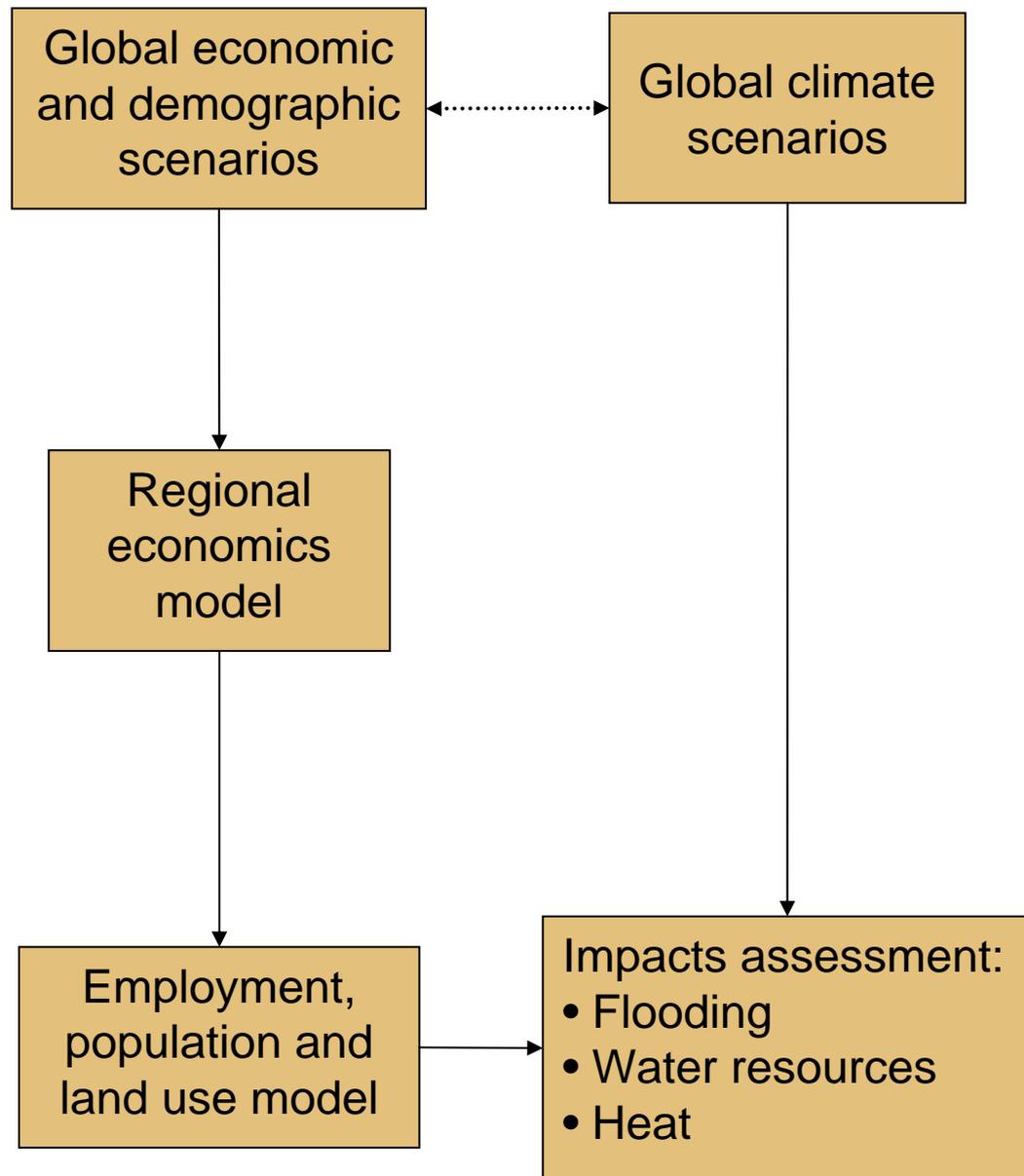
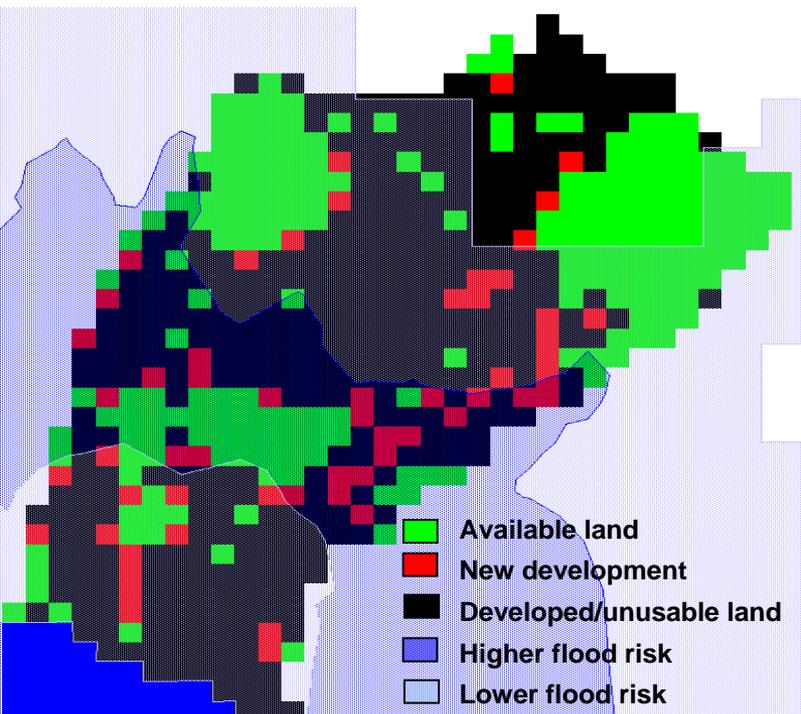


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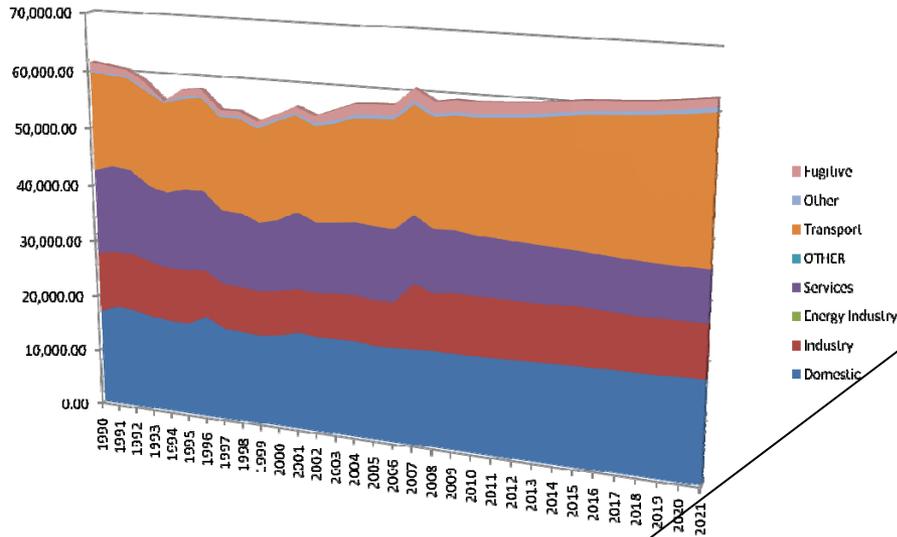
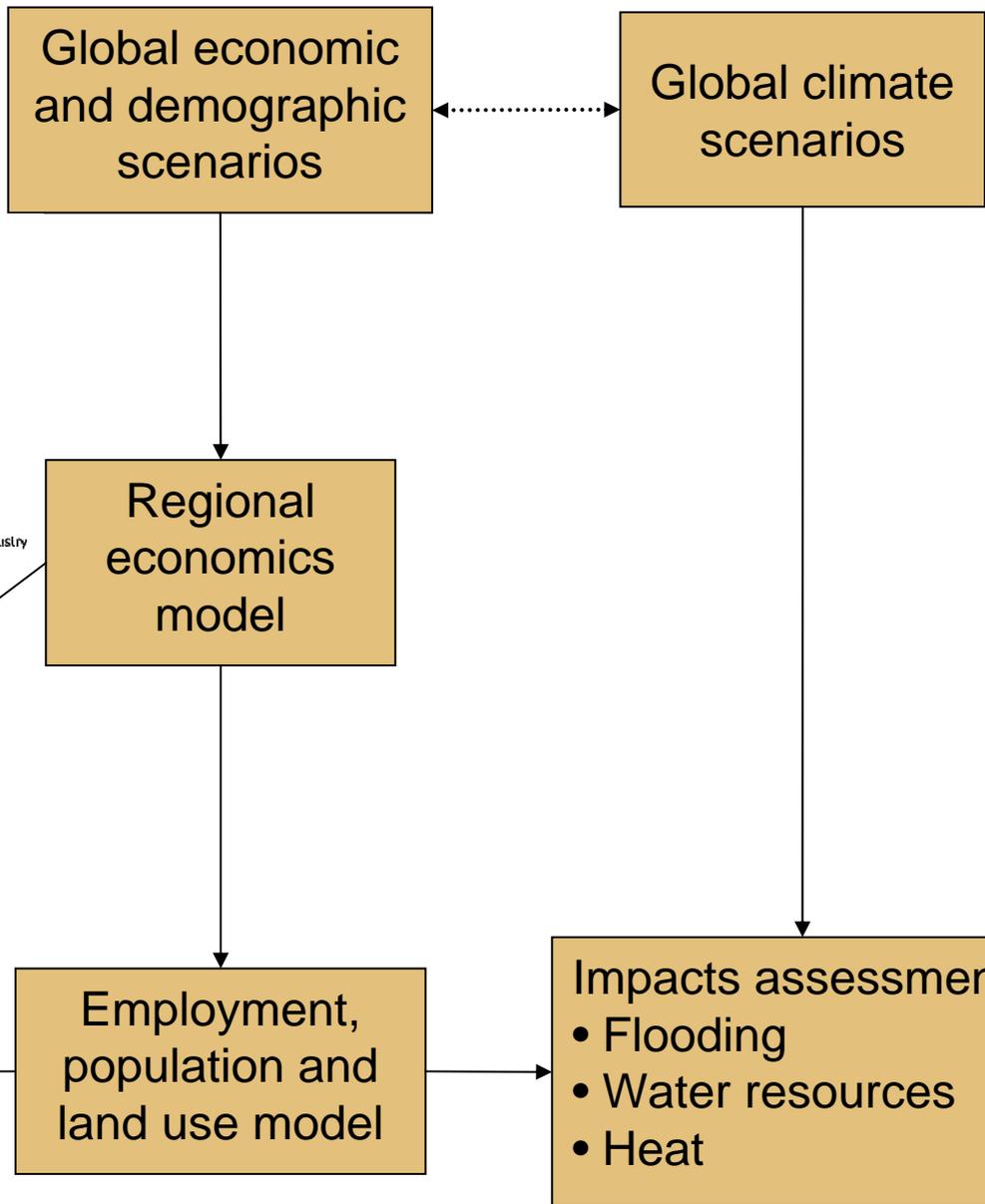


for climate change research

# 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<sup>o</sup> 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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## ECOPOLIS

*Last hope for the natural world*



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