Modern data science and efficient transport systems

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What is City Science?

An ambitious, young technology company within the Oxygen House family

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What is our mission?

- To optimise complex urban systems, reducing waste and improving lives
- We want to turn the data all around us into clear, scientific insight
- Enable decision makers to understand the effect of a change before it is implemented

How will we achieve it?

- Our team of data scientists and experts are developing analytical tools for the transportation and energy sectors
- We will use multiple datasets, statistical techniques and machine learning to develop scalable insight tools
- Working closely with partner cities we use data to develop solutions

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Ubiquity of Transport

- Economy
- Housing
- Social function
- Freedom
- Pollution
- Congestion
- Injury
- Health

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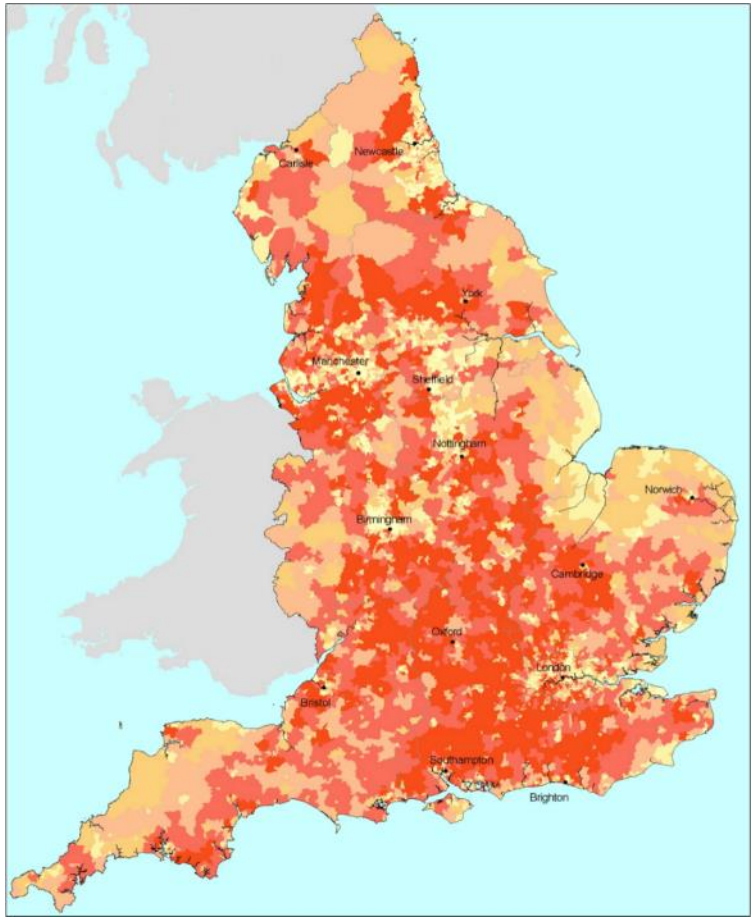
By 2035, diabetes care 'could cost the NHS £17 billion a year'



- Systematic review shows overwhelming health benefits of cycle commuting (11 fold).
- Active transport interventions in yellow shaded areas could have biggest impact on that bill.
- Small area estimates of 1 x 30 participation in Exercise among young adults (red high, yellow low)

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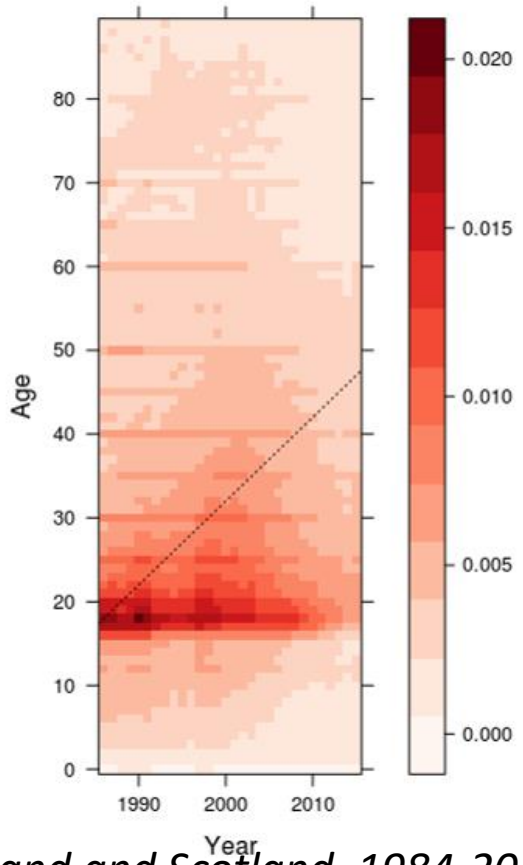
Strong Cohort Effects in Road User Behaviour



England and Scotland, 1984-2014, per capita road injury rates by age

- **This (simple) tool suggests cohorts born in the 1960s had a lot of fatalities as teenagers, and continued to have a lot of fatalities as they age**
- **Even more powerful effects seen for specific groups e.g. motorbikes**
- **Highlights importance of cohort effects in road user behaviour**

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Data Sharing

- **We have been fortunate with support and data provided by local Authorities, local Businesses and other stakeholders**
- **Many other (governmental) datasets are already fully open access data; if not they are available from UK Data Archive under varying levels of restriction**
- **Ethics issues have been thought through – *i.e.*, we should use professional approaches to disclosure control rather than *ad hoc* methods**
- **Köln: https://www.offenedaten-koeln.de/dataset/verkehrskalender-der-stadt-k%C3%B6ln**

National Guidance on Disclosure Control is available

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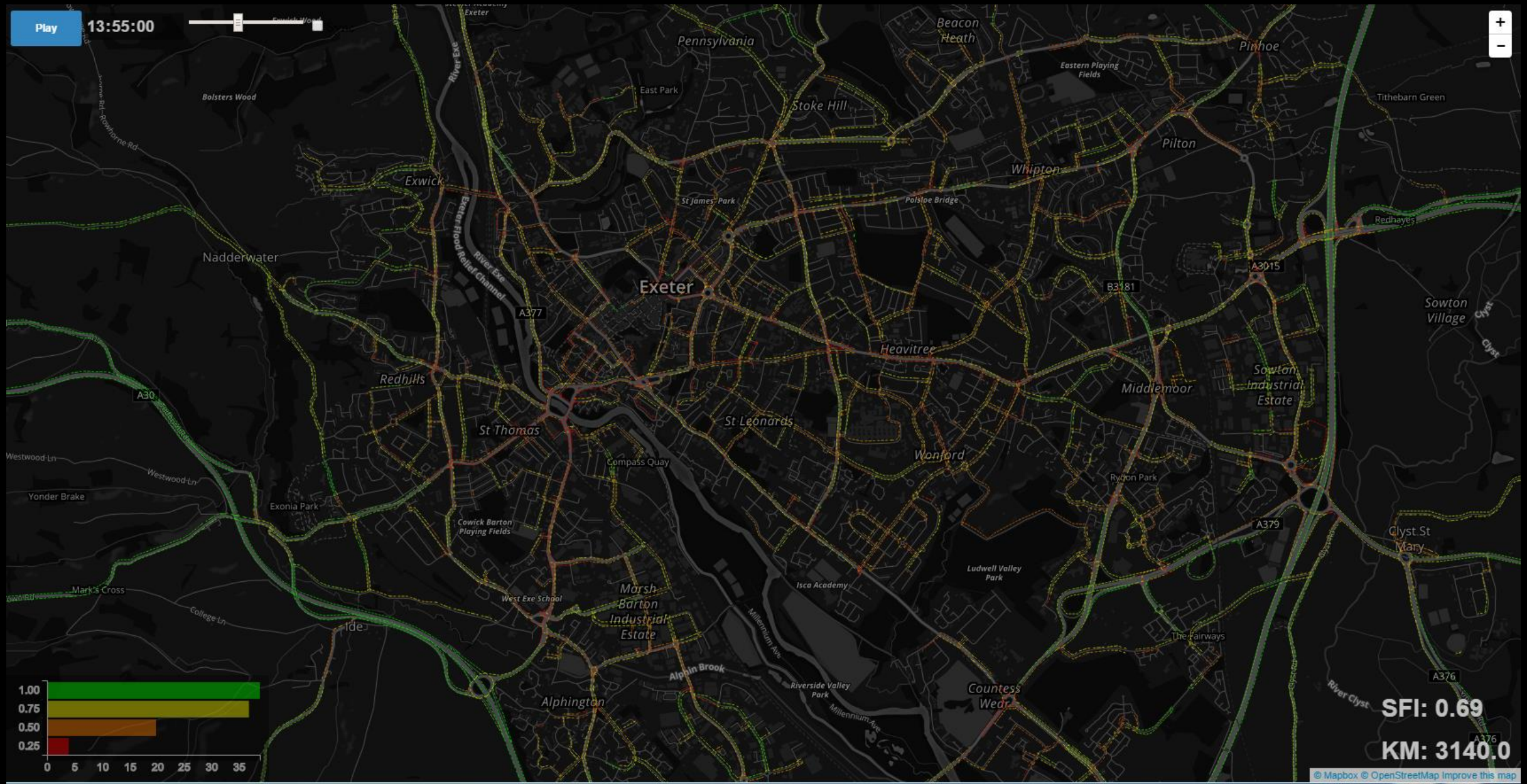

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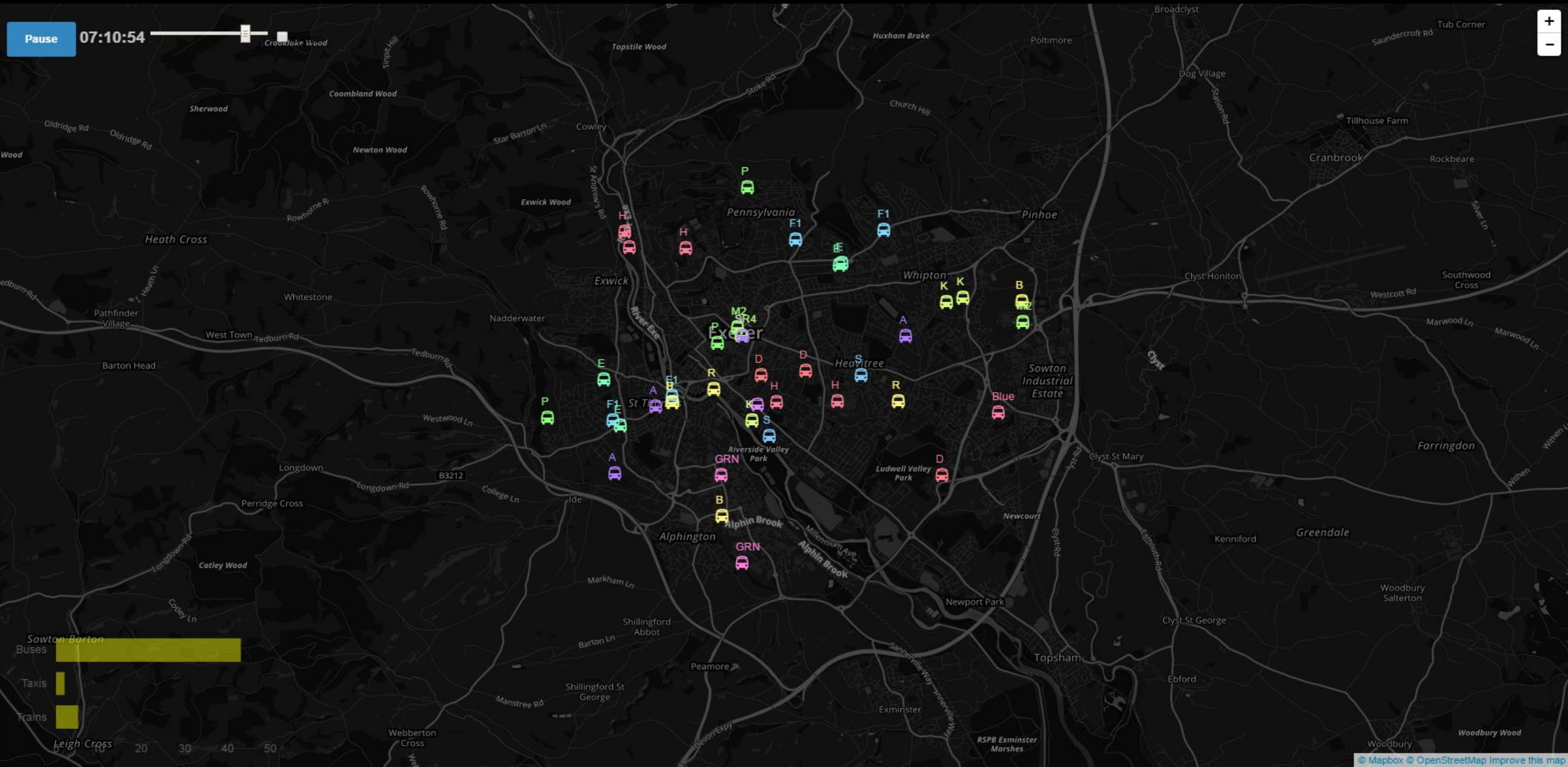

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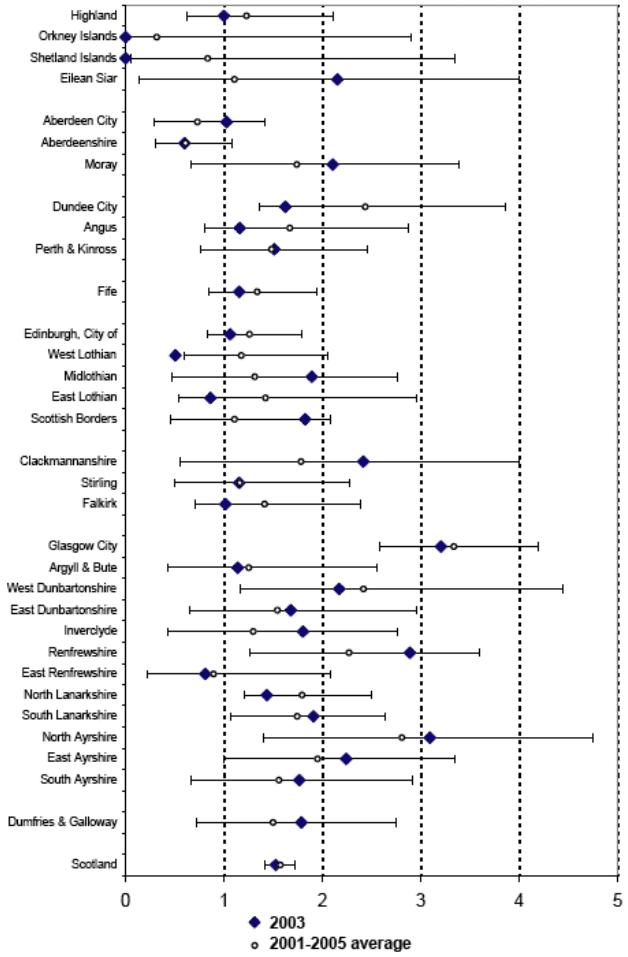
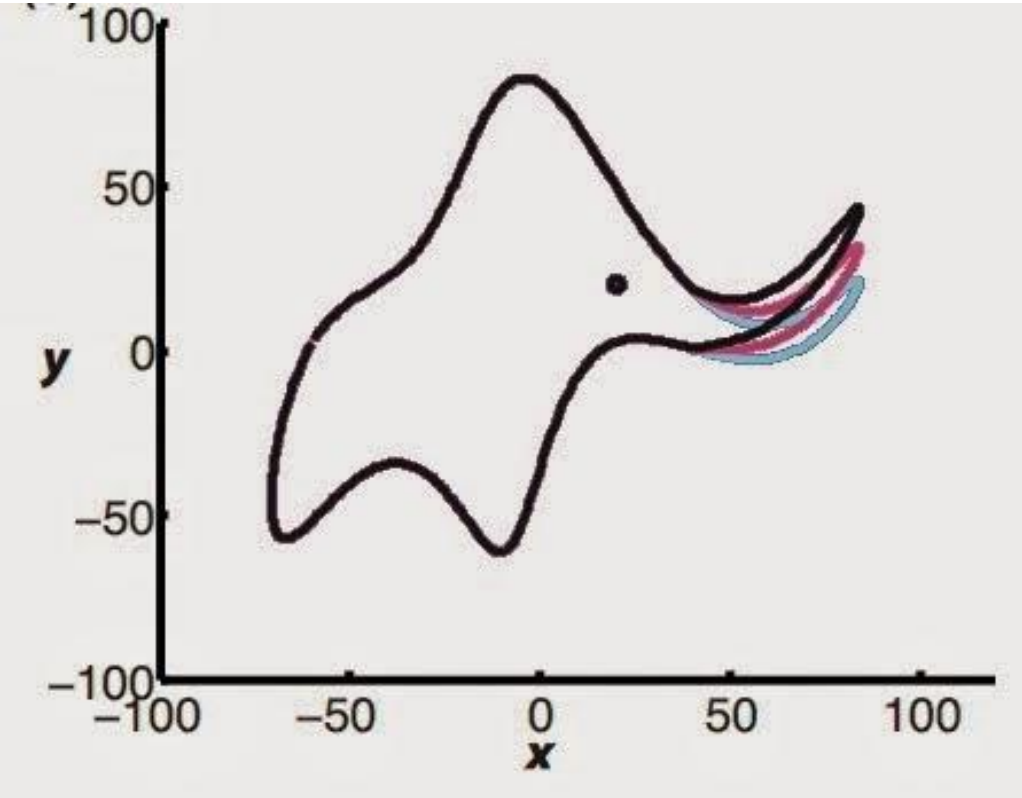
Statistical modelling and uncertainty



Scottish government estimates of child risk of fatal or serious injury as road user.

http://www.gov.scot/Publications/2009/11/23103624/66

Statistical Modelling and overfitting



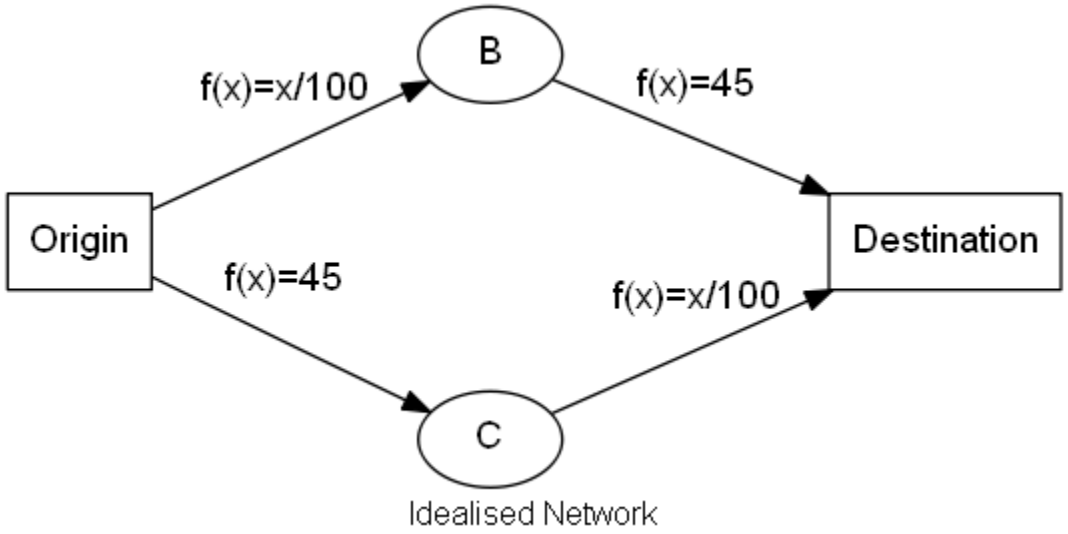
Von Neumann:
"With four parameters I can draw an elephant"

- "Drawing an elephant with four complex parameters" by Jurgen Mayer, Khaled Khairy, and Jonathon Howard, Am. J. Phys. 78, 648 (2010), DOI:10.1119/1.3254017

Assumptions to challenge

- **Are all the "parameters" (seasonal adjustments, annualization factors) sensible described as single fixed points.**
- **Transport networks used by humans (even if we all get driverless cars)**
  - **Do we always behave as economically rational mode / route selectors?**
  - **Do we all have 100% regularity in travel activity as we described in the census / that road side interview we did in 1998?**
  - **Does all our travel involve a single origin / destination?**

All models need ***ASSUMPTIONS***

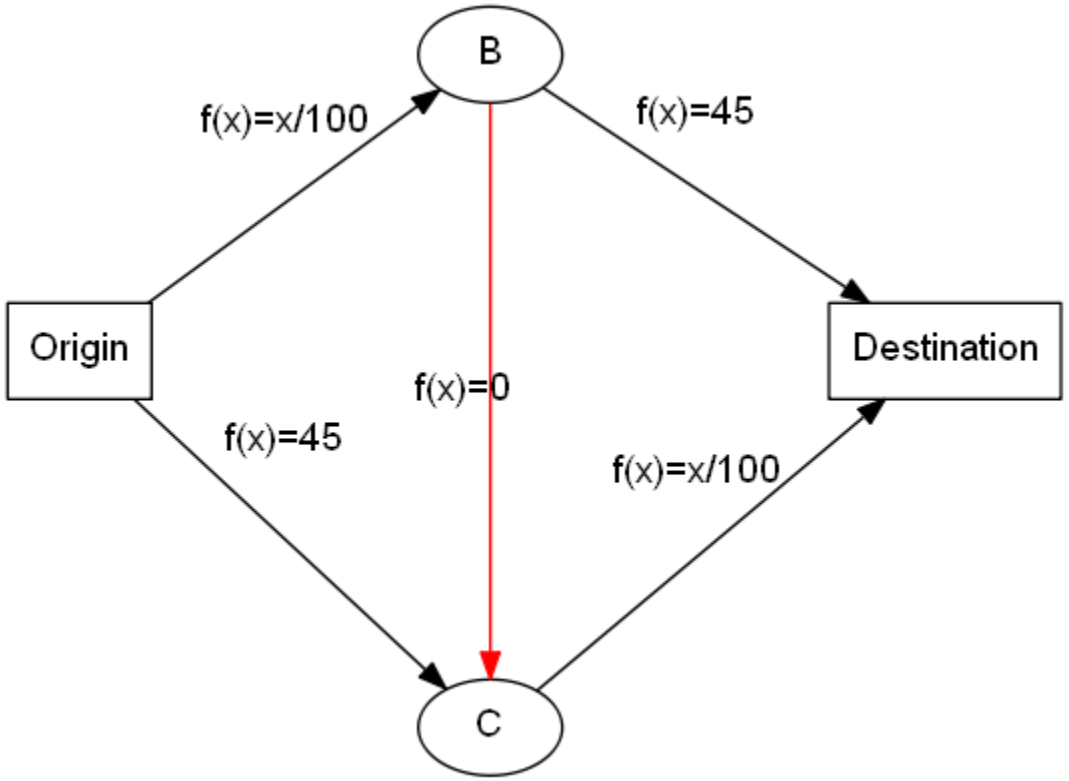


Idealised Network

For illustration - Braess paradox

- **4,000 cars travelling from Origin to Destination.**
- **A transport model would determine**
  - **equilibrium distribution has 2,000 vehicles on each route (O->B->D and O->C->D)**
  - **Optimum travel time 65 minutes.**

Mathematical modelling

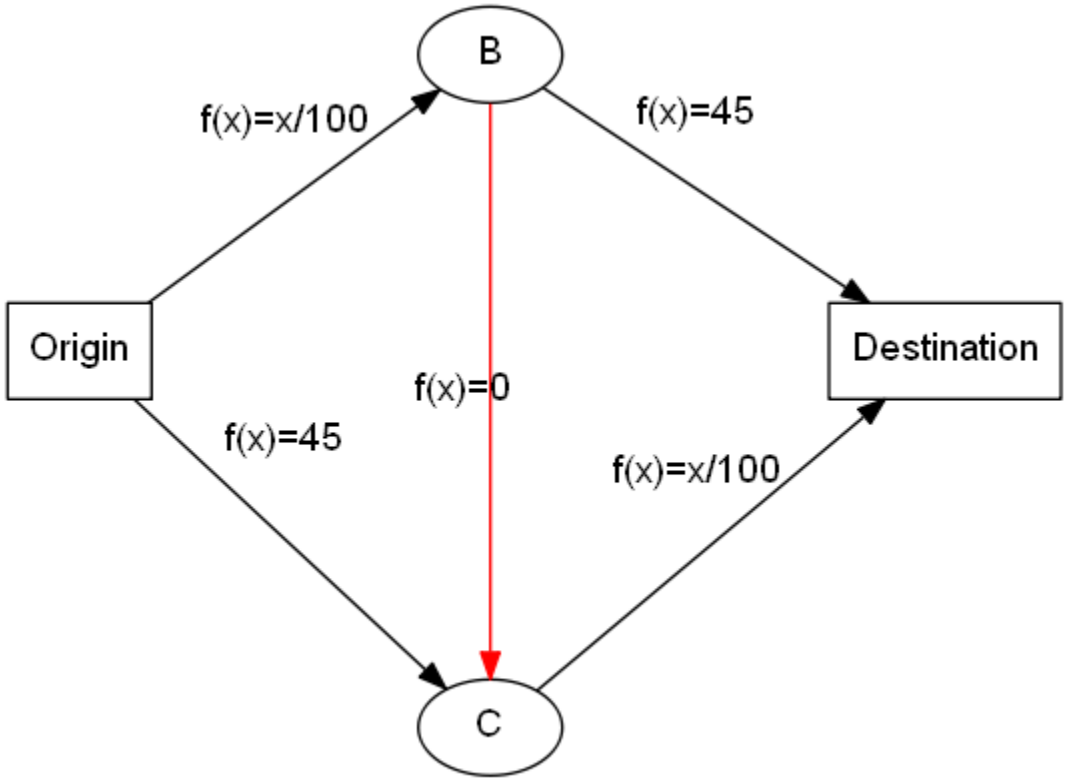


Idealised Network with Braess Paradox

Now add a link.

- **A transport model would determine**
  - **equilibrium distribution has 4,000 vehicles Origin -> B -> C -> Destination**
  - **Optimum travel time 80 minutes.**
- **There are real world examples used to argue this is a real phenomena.**

Mathematical modelling



Idealised Network with Braess Paradox

- **Filters (assumptions)**
  - **Drivers all have the same cost function (minimising time). What about avoiding congestion, difficult turns, traffic lights?**
  - **Drivers have only one purpose for a trip**
  - **What temporal and routing alternatives are available, and how do we cost them?**
  - **Actually, when evaluating public transport or road tolling we *don't* use these assumptions!**

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lightfoot Collaboration

- Route choices
- Junction behaviour
- Independent validation for pre and post activation

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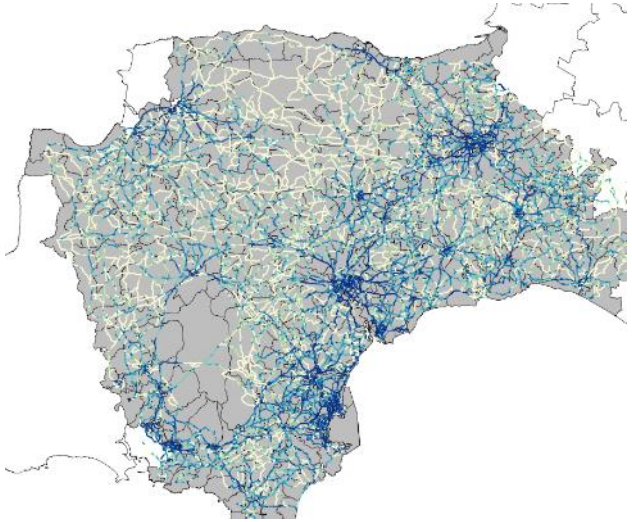
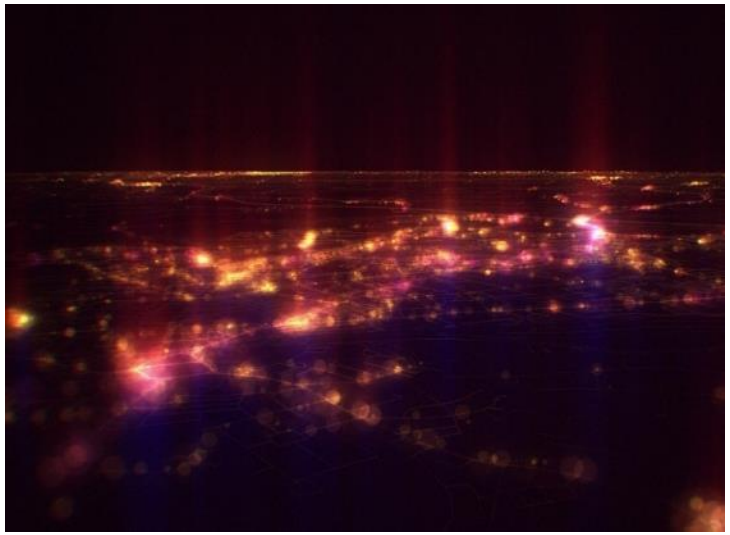
Data Collection

- New Data Collection Strategies
- Collating a wide-range of datasets in true partnership with local authorities, transport operators, private companies and beyond.



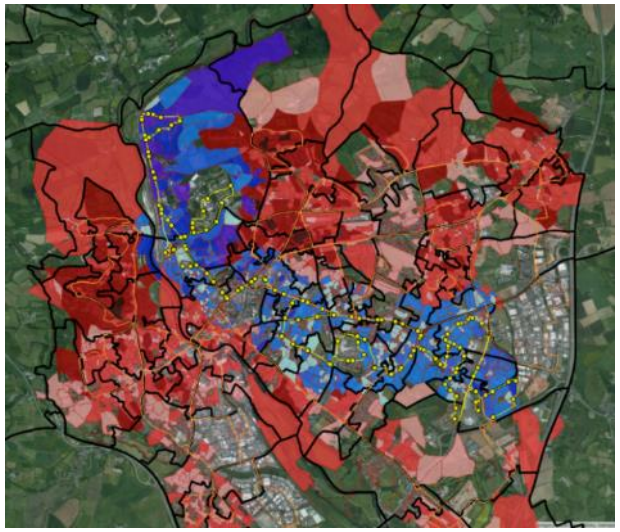
Insight

- Data-driven decision making with current state and a wider range of 'what-if' analyses.
- Using sophisticated modelling to identify pinch points and suggest low cost solutions to ease congestion – 'virtual roads'
- More analysis of how new trends will impact existing network infrastructure



Some Ideal Results

- Flexible transport plans enabling cities to adapt to the rapidly changing transportation environment.
- Integrating business cases which ensure that sustainable solutions make economic sense and can meet projected demands.
- Valuing a wider range of outcomes



A COLLABORATIVE DATA SCIENCE APPROACH TO TRANSPORTATION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ANY QUESTIONS?
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