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Climate change adaptation and transport

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Context

- TfL responds well to current extreme weather events
- Adaptation is included in plans for big infrastructure projects but often designed out later
- We understand some potential impacts but more evidence is required
- The MTS and LES are driving an increased focus on adaptation
- Climate impacts are managed as a strategic risk to TfL

"We will increase the degree to which London's transport network and supporting infrastructure are prepared for forecast impacts of severe weather and climate change, so that services can respond effectively to extreme weather events while operating safely, reliably and with a good level of passenger comfort."

Initial risk assessment

Mode	Risks	Impacts
Roads	Flooding	Availability of routes
Buses	Flooding Temp fluctuations	Passenger comfort Availability of routes
Track	Flooding Extreme heat	Buckling Signal and power outages
Trains	Extreme heat Drought	Passenger comfort Electricity brown-outs Lineside fires

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TfL adaptation work programme

- Identify key research topics

- Set up Transport Adaptation Steering Group

- Workshops with TfL asset managers and boroughs

- Examine correlation/causality between selected modes and weather types

- **Propose metrics to measure resilience to climate change and extreme weather**

- Strengthen internal processes for climate change adaptation and projects

- Develop an adaptive pathways framework.

High temperatures, delays and the London Underground

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Purpose of study

- To statistically test whether there is a relationship between temperature and delays on the London Underground (LU).

- To identify any LU assets with stronger relationships than others.

- To provide an evidence base to support TfL in next steps for research.

- Undertaken for MSc Dissertation.

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Network Rail have identified a relationship between temp and the number of incidents

- NR investigated 'resilience of assets to improve understanding of how they may operate in future climate conditions'.
- This is very powerful and similar analysis would be useful for TfL
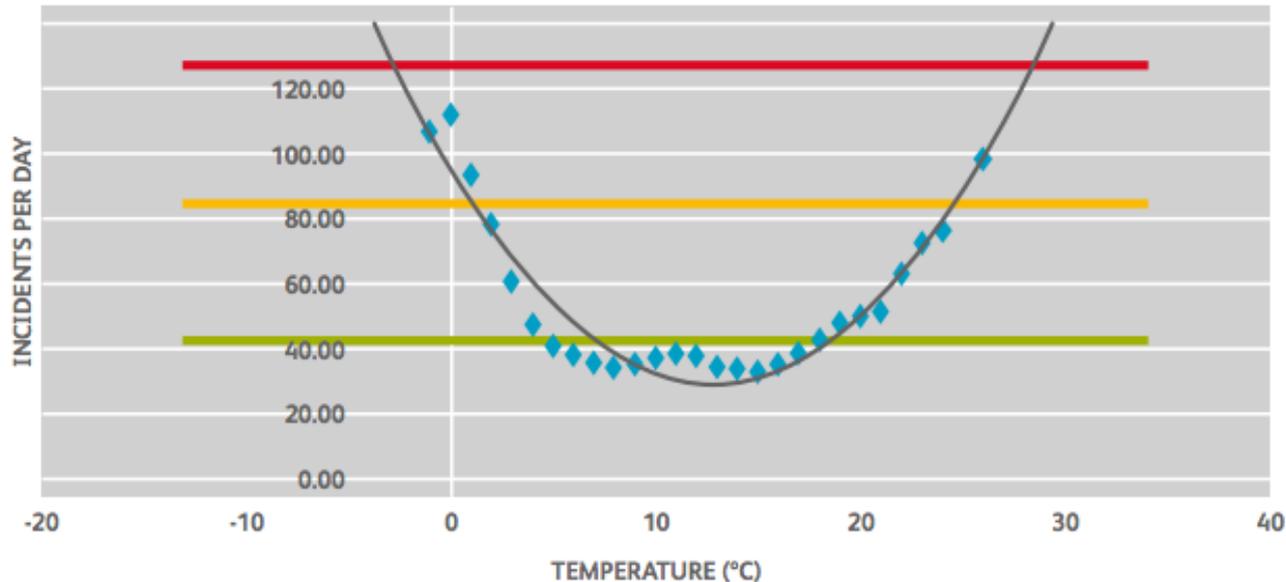
Thresholds identified as 'not significant' (green); 'significant' (yellow) and 'very significant' (red). (Network Rail, 2015)

Methodology was driven by data availability

- **Met Office:** air temperature data (2011-2016)

- **TfL:** delay data (2011-2016), categorised by cause

- Datasets compared by proximity of weather stations to LU stations

- Five variables tested including delay frequency, delay length and Lost Customer Hours

Frequency of delays is strongly related to increases in temperature

Relationship between mean daily frequency of delays and mean daily maximum temperature for all data: 2011-2016

$y = 0.117x^2 - 3.023x + 54.590$
$r^2 = 0.907$
$p < 0.001**$
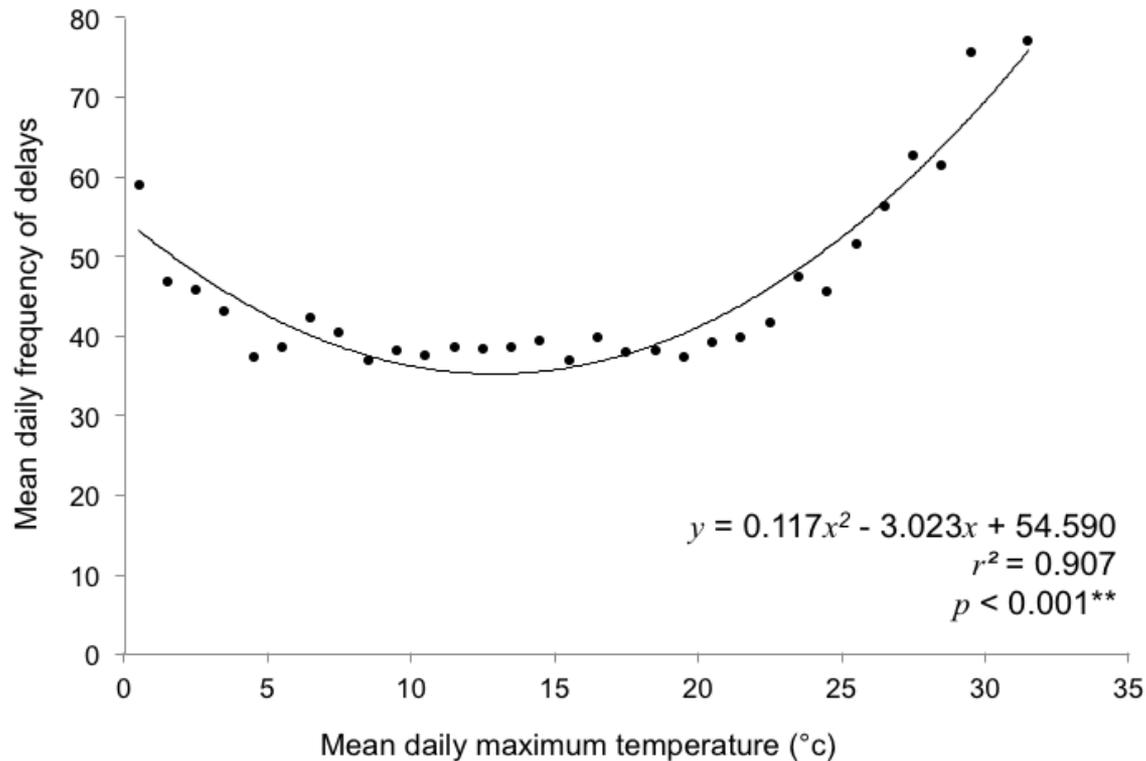
Some lines have a much stronger relationship than others

Relationship between mean daily frequency of delays and mean daily maximum temperature for all data broken down by LU line: 2011-2016
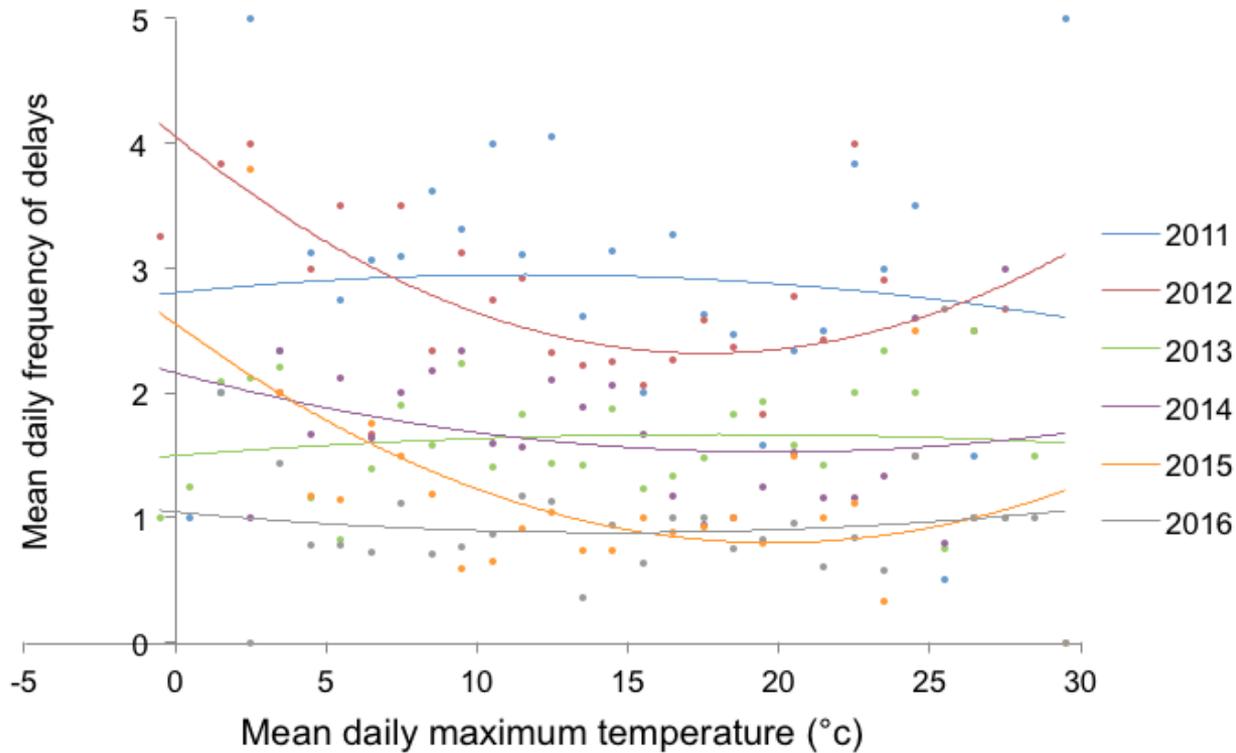

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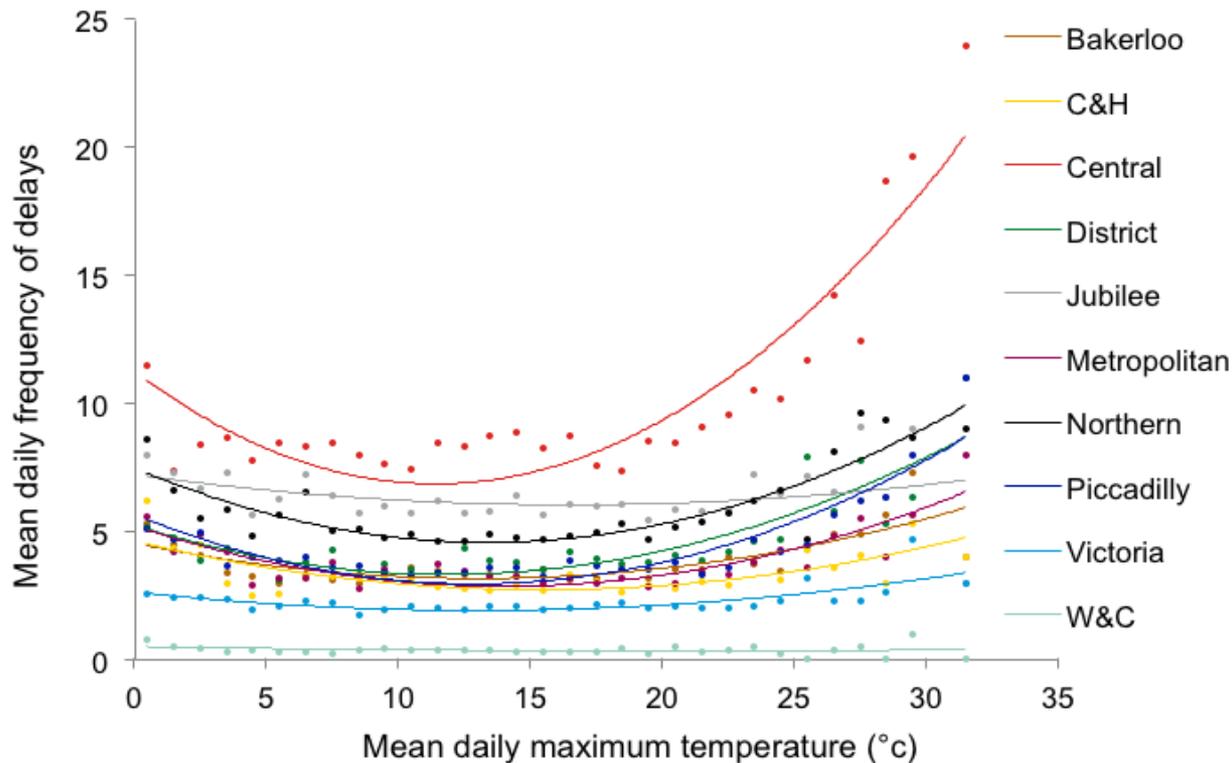
Relationship between temperature and asset failure

Relationship between mean daily frequency of delays and mean daily maximum temperature for all data broken down by cause category: 2011-2016
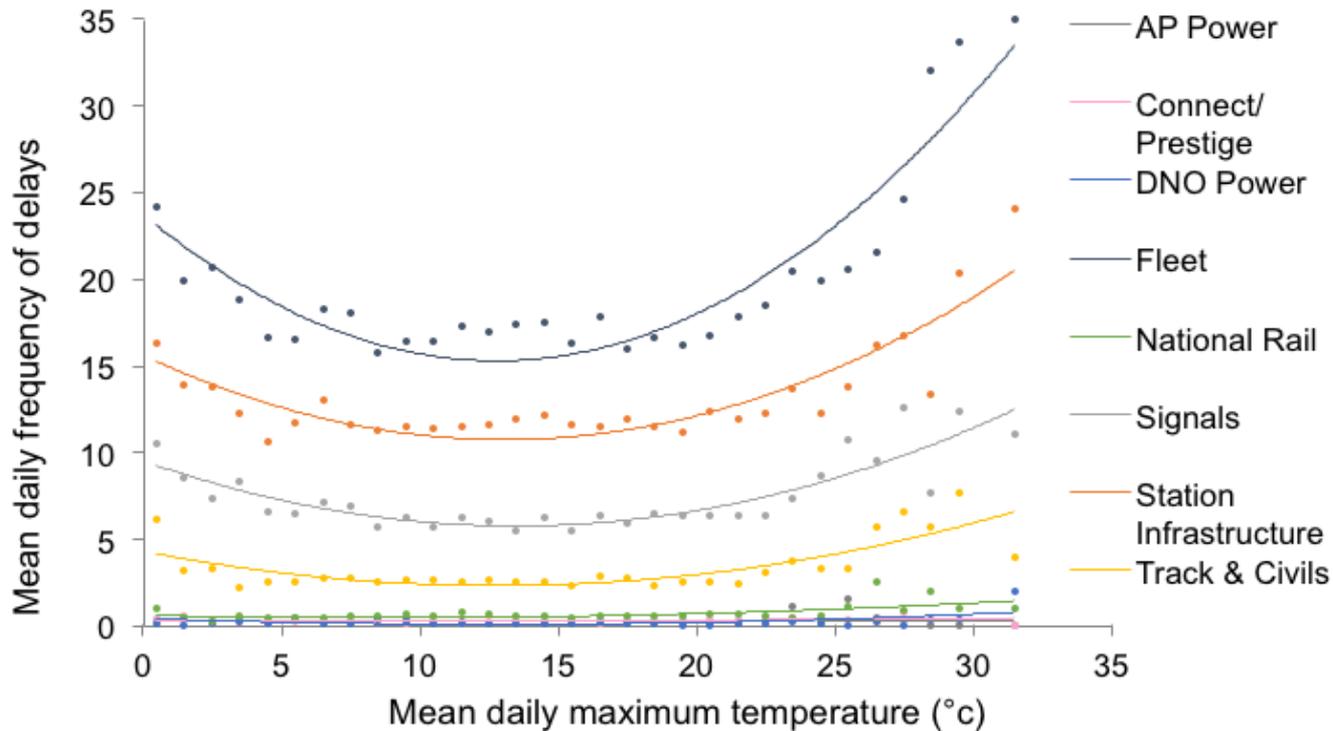
New rolling stock: Metropolitan line improvements

Relationship between mean daily frequency of delays and mean daily maximum temperature for Metropolitan line's fleet by year: 2011-2016

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Lifts and escalator failures have a strong relationship with temp across numerous LU lines

Relationship between mean daily frequency of delays and mean daily maximum temperature for Circle, Hammersmith & City, Metropolitan, Northern and Piccadilly line's station infrastructure assets showing the strongest relationships: 2011-2016

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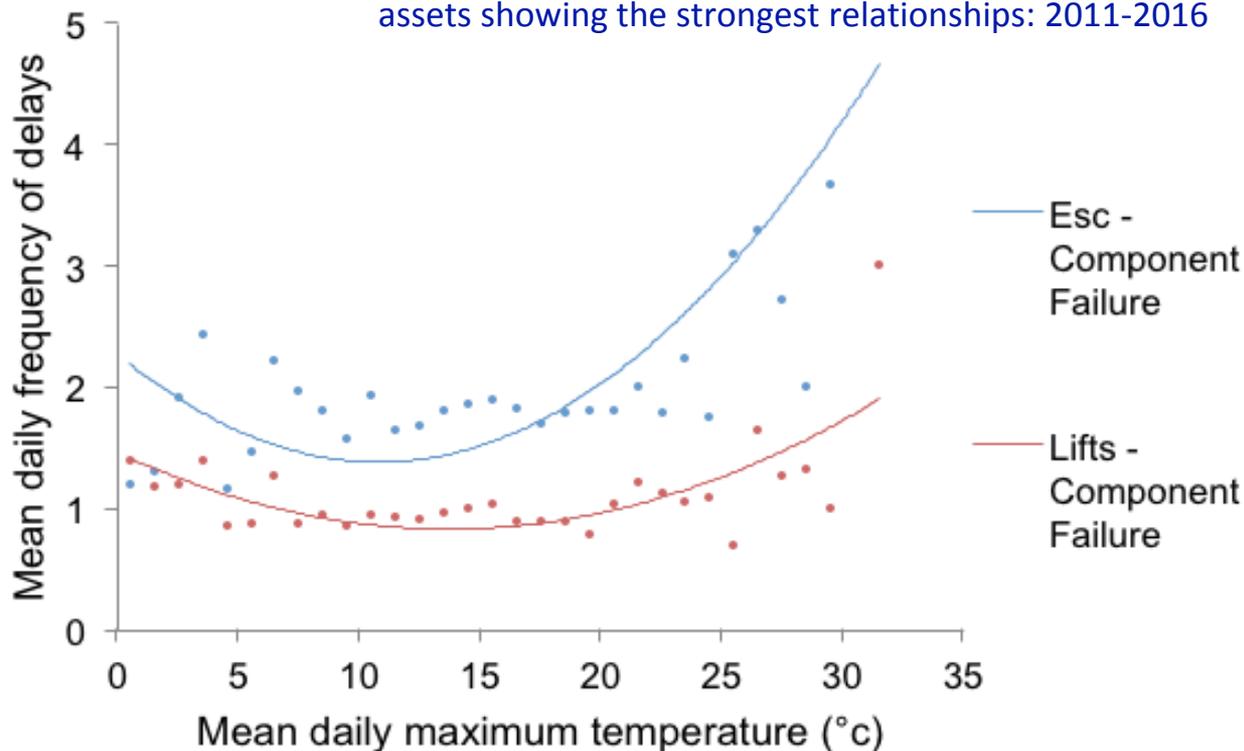
Conclusions and next steps

- There is a trend of increases in delays when temperatures exceed c.15 degrees, particularly frequency of delay

- Track problems and failures are not strongly linked with higher temperatures and delay

- Using frequency and length of delays to measure asset relationship to weather events may enable:
    - Benchmarking with other metro/rail networks
    - Conducting similar research for other modes/weather types

- Research found **correlation not causality**. Further work needed to identify causal and mediating factors

Heat and passenger comfort?

- Not in scope of this piece of research. Impact of heat on passengers already well research and plans in place to manage
- Passengers who are pre-disposed to being unwell may be more likely to have this exacerbated by temperature. We compared rates of passengers ill and hot weather but found no link
- Increased demand (rather than ambient temps.) likely to increase heat in LU trains
- LU assessing cost-benefit of improved energy efficiency to reduce waste heat and further cooling of stations and tunnels
- Programme considers climate change within the life of the assets i.e. typically 35-40 years
- Ventilation may become less effective as temperatures rise

Contact

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