SpaceTimeLab

SpaceTimeLab's mission is to generate actionable insights and foresights from geo-located and time-stamped data for government, business and society. Using integrated space-time thinking, a network-based approach and cutting edge AI, we engineer solutions to improve the mobility, safety, health and prosperity of urban living

SpaceTimeLab
10th Anniversary

UCL ENGINEERING
Change the world

Our Portfolio

Our current project portfolio covers four interconnected themes:

Transport & Mobility	Safety & Security	Business Intelligence	Health & Wellbeing
Research Topics			
• Active travel & decarbonisation • Travel mode detection & pattern analysis • Traffic forecasting • Disruption simulation & estimation • Dynamic networks	• Crime prediction • Strategic planning • Intelligent patrolling • Performance evaluation • Public confidence modelling • Abnormal behaviours	• COVID-19 recovery & levelling up • High street & place vitality • Work from home pattern analysis • Targeted advertisement & catchment analysis • Conversational Systems	• Predicting pandemic spread • Effects of COVID-19 on transport and mobility • Computer vision-based risk analysis • Incident detection • Policy optimisation • Decision making
Data Sources			
• Mobile GPS dataset • Smart card data • Bike share • Traffic data • Travel demand survey	• Video and image data • Action cameras • Traffic incidents & crime • Police patrol data • Offender data	• Social media data • Retail data • High street and consumer data • Natural language and text • Smart meters	• COVID-19 cases and deaths • Patient trajectories • Street view imagery • Fitness tracking
Latest funded projects			
UCL 100 Cyclists Study	COVID Mobility Place — Enhancing Insights, Preserving Tomorrow	Consumer Data Research Centre	alexa prize
Completed projects			
STANDARD — Spatio-Temporal Analysis of Network Data and Route Dynamics	GRAND CHALLENGES — Crime Policing Citizenship: space-time interactions of dynamic networks	WalCycData	VIRUS WATCH / INFRARISK

Funders and partners

Sainsbury's • XRENEWABLE • LFB LONDON FIRE BRIGADE • esri • DSO • BT • Department for Transport

CATAPULT Connected Places • British Gas • Office for National Statistics • Ordnance Survey

TRANSPORT FOR LONDON EVERY JOURNEY MATTERS • ublox • EPSRC Engineering and Physical Sciences Research Council • ESRC Economic and Social Research Council • JRC EUROPEAN COMMISSION • UK Health Security Agency • eit Urban Mobility Funded by the European Union • Road Safety Trust Supporting Road Safety

METROPOLITAN POLICE • THE ROYAL SOCIETY • ARUP • STRAVA • PowerHUB Power for Ventures

City of Munich Department of Mobility • ŠKODA • TECHNION Israel Institute of Technology • Fraunhofer • upf. Universitat Pompeu Fabra Barcelona • UPC UNIVERSITAT POLITÈCNICA DE CATALUNYA BARCELONATECH
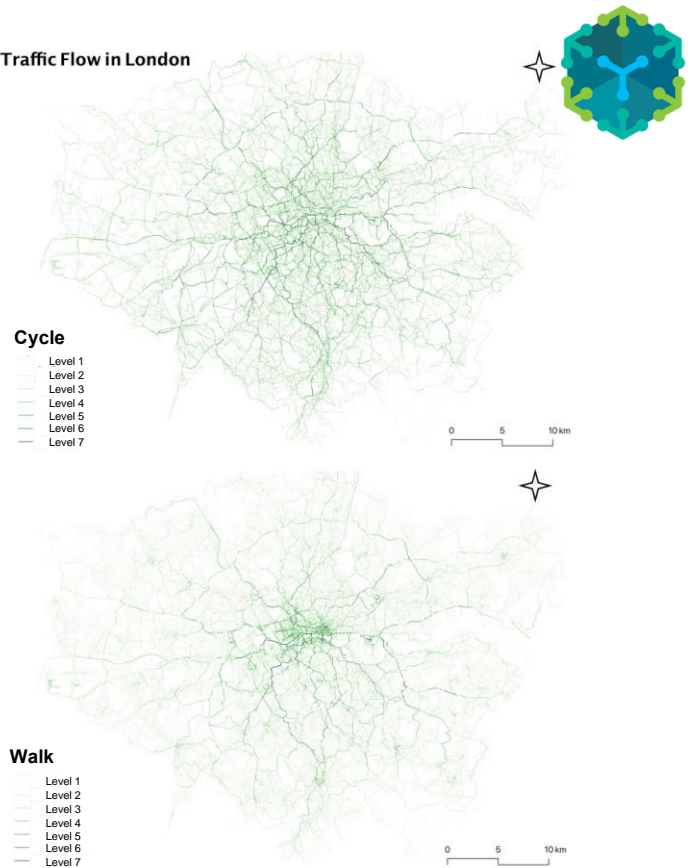
Transport and Mobility

The transportation system is the lifeblood of the city. At SpaceTimeLab, we work to ensure the health of the city by improving the mobility of its citizens and the function of its transportation system.

SpaceTimeLab is working on a number of projects using new forms of data to derive multimodal mobility insights to support decision making.

Examples of our work include:

1. Extracting multimodal transport flows from massive GPS data

2. Understanding traveller behaviour and patterns

3. Estimating transport greenhouse gas emissions

4. Evaluation of transport interventions (low traffic neighbourhoods), investments (Elizabeth Line) and disruptions (Tube strikes)

5. Profiling traveller behaviour using smart card data.

6. Prediction, simulation and visualisation of urban traffic flows and congestion on dynamic networks.
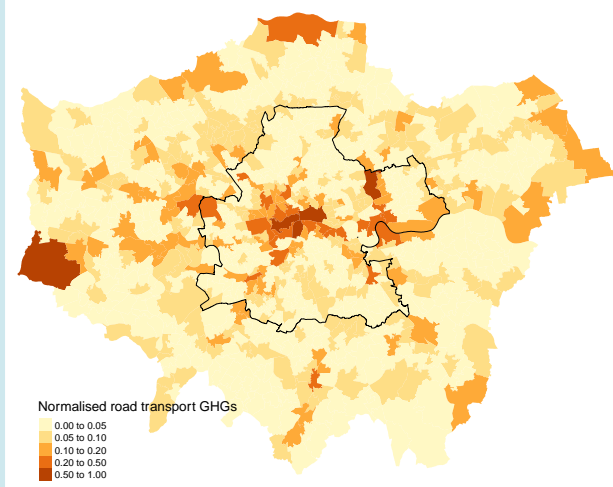
Traffic Flow in London

Cycle
Level 1
Level 2
Level 3
Level 4
Level 5
Level 6
Level 7

0   5   10 km

Walk
Level 1
Level 2
Level 3
Level 4
Level 5
Level 6
Level 7

0   5   10 km

We use massive GPS data to infer travel modes and estimate flows

Spotlight:
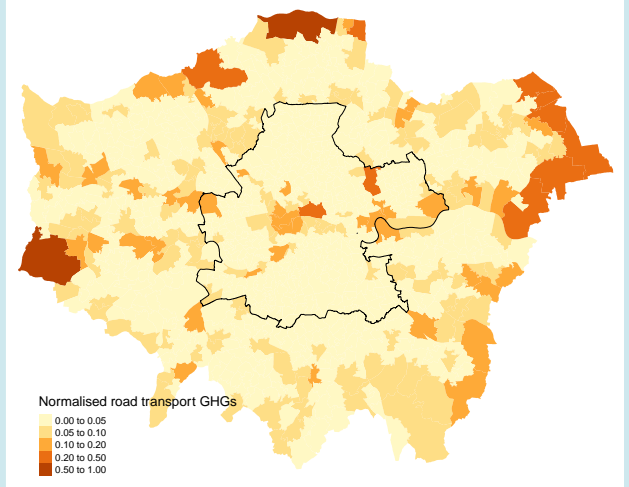## Greenhouse Gas Emissions from Transport pre and post pandemic

We use massive scale, high frequency, GDPR compliant mobility data to infer the greenhouse gas (GHG) emissions of all transport modes

Before the COVID−19 pandemic

Normalised road transport GHGs
0.00 to 0.05
0.05 to 0.10
0.10 to 0.20
0.20 to 0.50
0.50 to 1.00

After the COVID−19 pandemic

Normalised road transport GHGs
0.00 to 0.05
0.05 to 0.10
0.10 to 0.20
0.20 to 0.50
0.50 to 1.00

- Individual level transport data is used to reveal dynamic changes
- All travel modes are included using our mode detection algorithms
- Our approach is portable and scalable for estimating multi-scale transport GHG emissions

Safety and Security

Citizens have the right to feel safe and secure in their daily lives. SpaceTimeLab works to improve the safety and wellbeing of citizens through our pioneering work in crime prediction and road safety analysis. Our methods integrate the urban network structure to enable more accurate and specific insights.

Examples of our work include:

1. Spatio-temporal clustering of criminal activities

2. Network based crime and traffic incident forecasting using graph deep learning

3. Simulation and optimisation of police activities and resource allocation

4. Computer vision based risk analysis for vulnerable road users

5. Understanding safety from crowd-sourced street view imagery

6. Development of edge devices for real-time risk detection
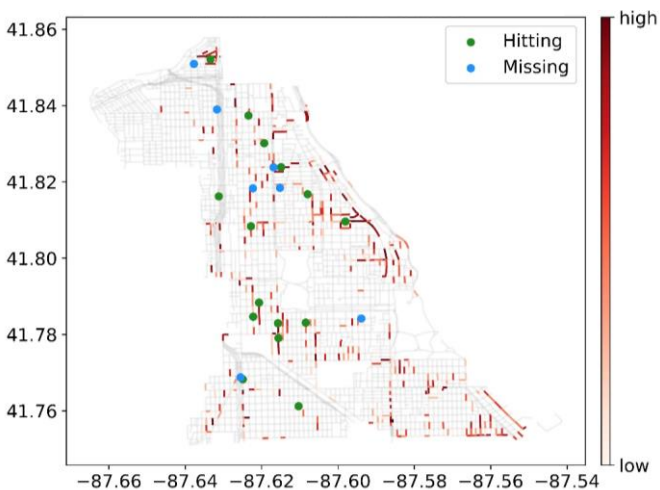

The figure shows prediction of crime risk in Chicago using graph deep learning. The green points show where observed crimes fall on our predicted road segments

Our crime forecasting algorithms are currently in daily operation within the London Metropolitan Police Service

Spotlight:
The 100 Cyclists Project

The safety of vulnerable road users remains a significant barrier to the uptake of active travel modes. The 100 Cyclists Project seeks to understand the risk factors associated with cycling in London using panoramic video and telematics collected by cyclists. Computer vision based on deep learning is used to automatically analyse near-miss scenes, generating insights that can be used to understand and improve road safety.
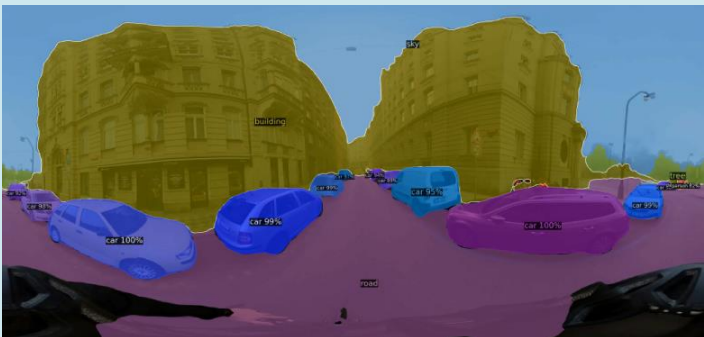
The figure above shows panoptic segmentation of panoramic video to extract objects and surfaces

The left figure shows dynamic tracking of passing vehicles from a helmet mounted panoramic camera

Business Intelligence

Many facets of business and commerce can be rationalised and improved through an understanding of the spatio-temporal patterns underlying consumer behaviour.

We turn consumer data into insights, helping businesses to understand who their customers are, where they travel, how they travel and how long they stay.

Examples of our work include:

1. Footfall and catchment area estimation

2. Consumer profiling

3. High street vitality analysis

4. Investigating post COVID-19 working & visiting patterns

5. Fleet and logistics management

6. Targeted advertisement
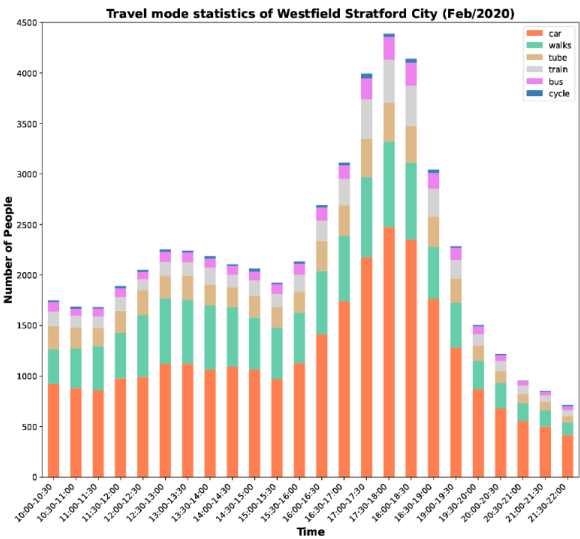
This figure shows the number of people visiting Westfield Stratford City, London, broken down by time of day and transport mode

Spotlight:
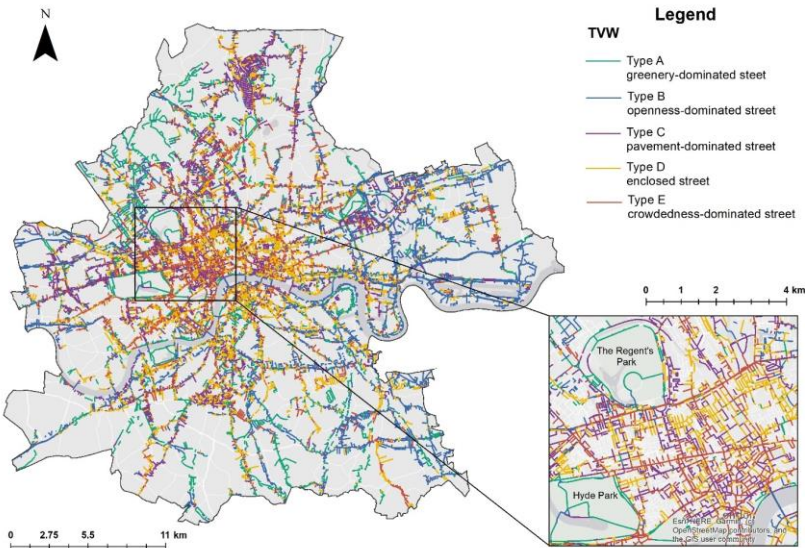### Modelling the impact of COVID-19 on high streets

High streets were hit hard during the COVID-19 pandemic. Understanding how they recover is essential for making leveling-up plans and redevelopment strategies. We use footfall from GPS mobility data to identify groups of high streets with similar dynamics.

Footfall clusters

Change in footfall within clusters

Composition of clusters
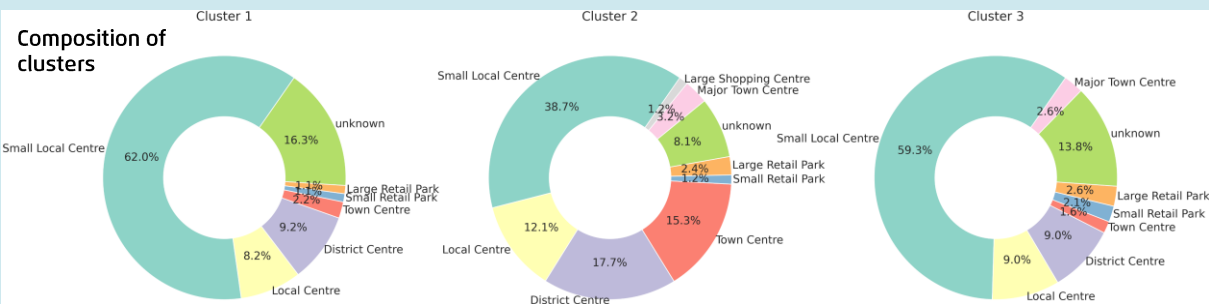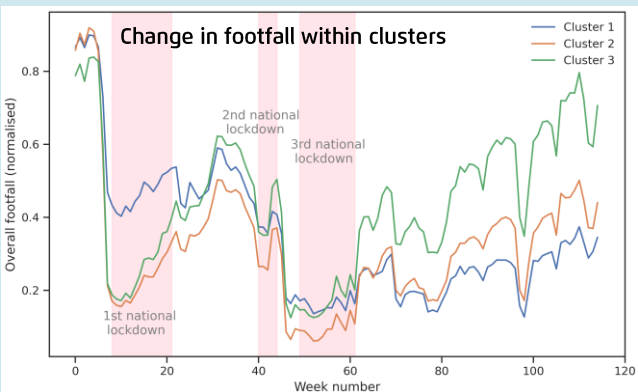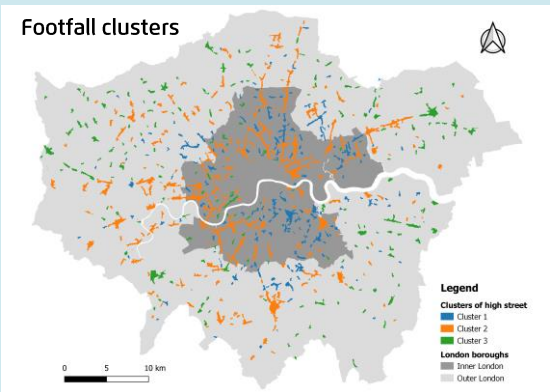
Health and Wellbeing

Public health and wellbeing has been brought into sharp focus since the beginning of the coronavirus pandemic. We have taken a leading role in the coronavirus response as part of the Virus Watch project. We also use advanced analytics to understand the liveability of cities

Legend

TVW

Type A greenery-dominated street
Type B openness-dominated street
Type C pavement-dominated street
Type D enclosed street
Type E crowdedness-dominated street

Examples of our work include:

1. Analysing changes in individual mobility throughout the stages of the pandemic

2. Measuring the impact of COVID-19 on urban transport systems

3. Combining urban data and deep learning to understand liveability

4. Using social media to understand disease spread

5. Conversational systems for healthcare services

The physical environment impacts on the liveability of cities. This figure shows clusters of urban street types extracted from crowd sourced Mapillary street view images using deep learning

Spotlight:

Virus Watch (https://ucl-virus-watch.net/)

Virus Watch is a research study of COVID-19 run by UCL in conjunction with the NHS. This household study aims to identify how the virus spreads in communities and how to stop it. Since the study began in June 2020, almost 60,000 people have contributed to the study via weekly and monthly surveys, and laboratory testing of immunity.

Within Virus Watch, SpaceTimeLab's role is to understand the impact that COVID-19 has had on individuals' mobility and how that impact varies by sociodemographics.
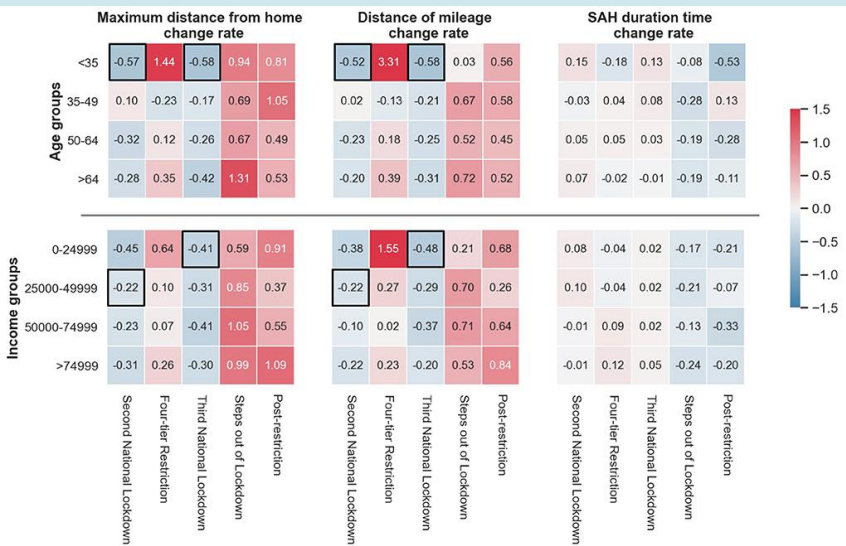
This figure shows how relative changes in mobility vary according to age and income at each stage of the COVID-19 pandemic
(SAH = stay at home)

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