ANALYSING RAILWAY INFRASTRUCTURE UTILISATION

A Geospatial Approach

Stuart Gordon

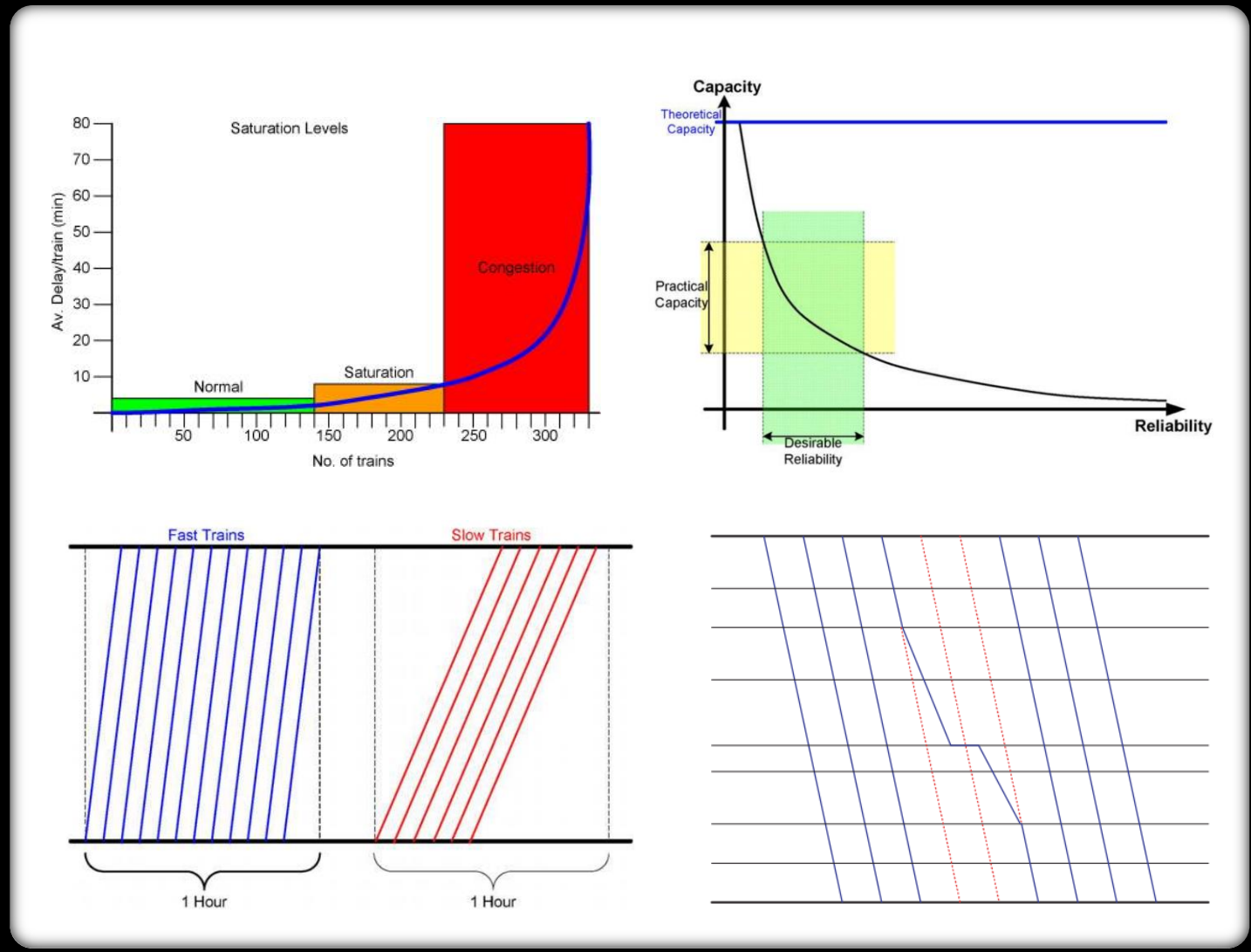
Supervisors: Dr Craig Robson, Professor Roberto Palacin

Oliver Bratton (Network Rail)

Newcastle University GEOSPATIAL SYSTEMS CENTRE FOR DOCTORAL TRAINING NetworkRail UKRI UK Research and Innovation

RAILWAY UTILISATION

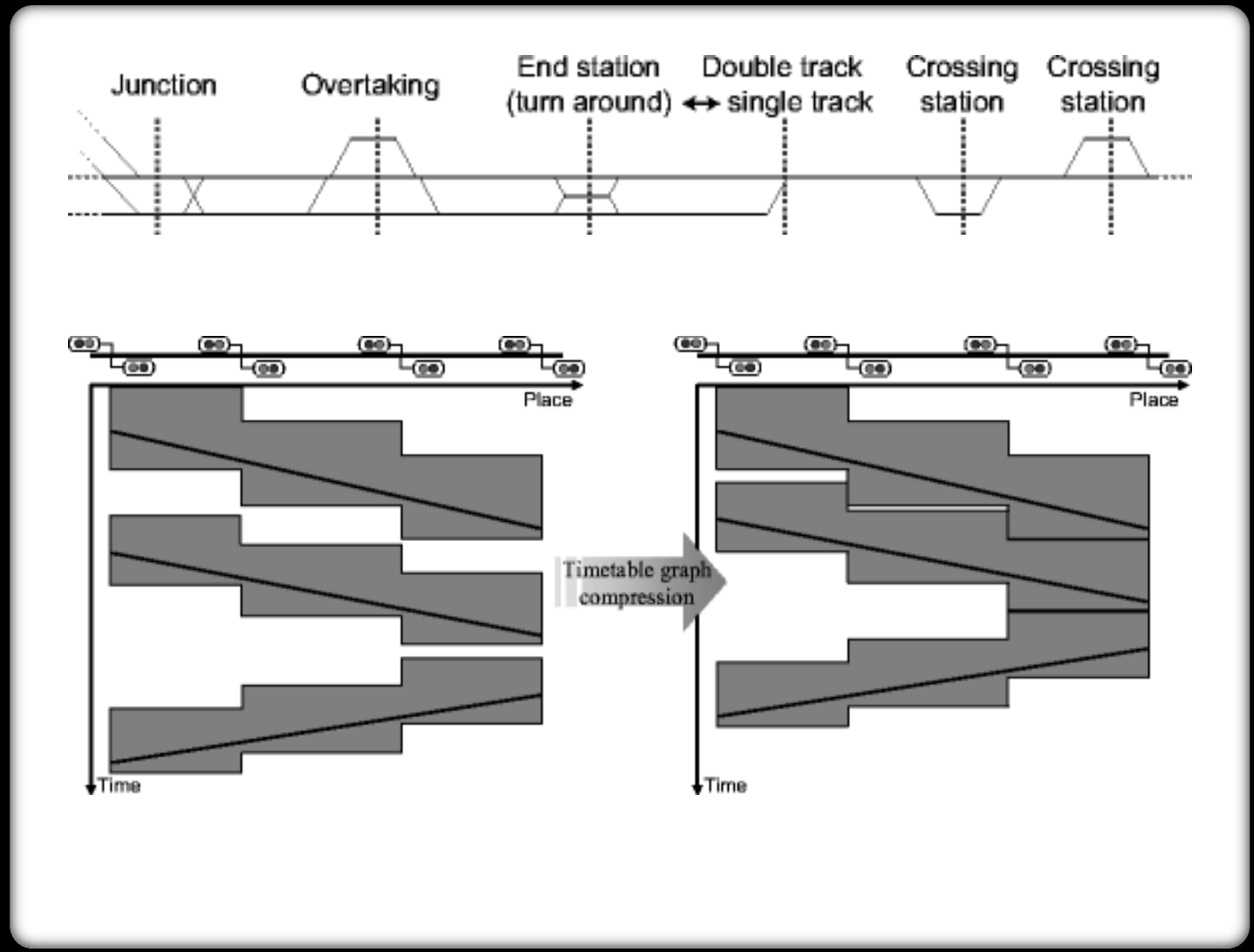
- Standard is UIC406
- Simulation over topological models
- Rare use of empirical data
- No validation of real world predictions
- Many variations of methods and methods to optimize



Abril et al, 2008. An assessment of railway capacity. Transportation Research Part E: Logistics and Transportation Review, 44(5), pp.774-806.

LITERATURE

- Logical Infrastructure linked to Timetable
- Standard Approach UIC406
- Simulation over topological models
- Rare use of empirical data
- No validation of real world predictions
- Many variations of methods and ways to optimize



Landex, A. Evaluation of Railway Networks with Single Track Operation Using the UIC 406 Capacity Method. *Netw Spat Econ* **9**, 7–23 (2009). https://doi.org/10.1007/s11067-008-9090-7

AIMS

Investigate Utilisation

Compare Planned against Actual Utilisation

Identify Events or Incidents

OBJECTIVES

Geospatial Infrastructure

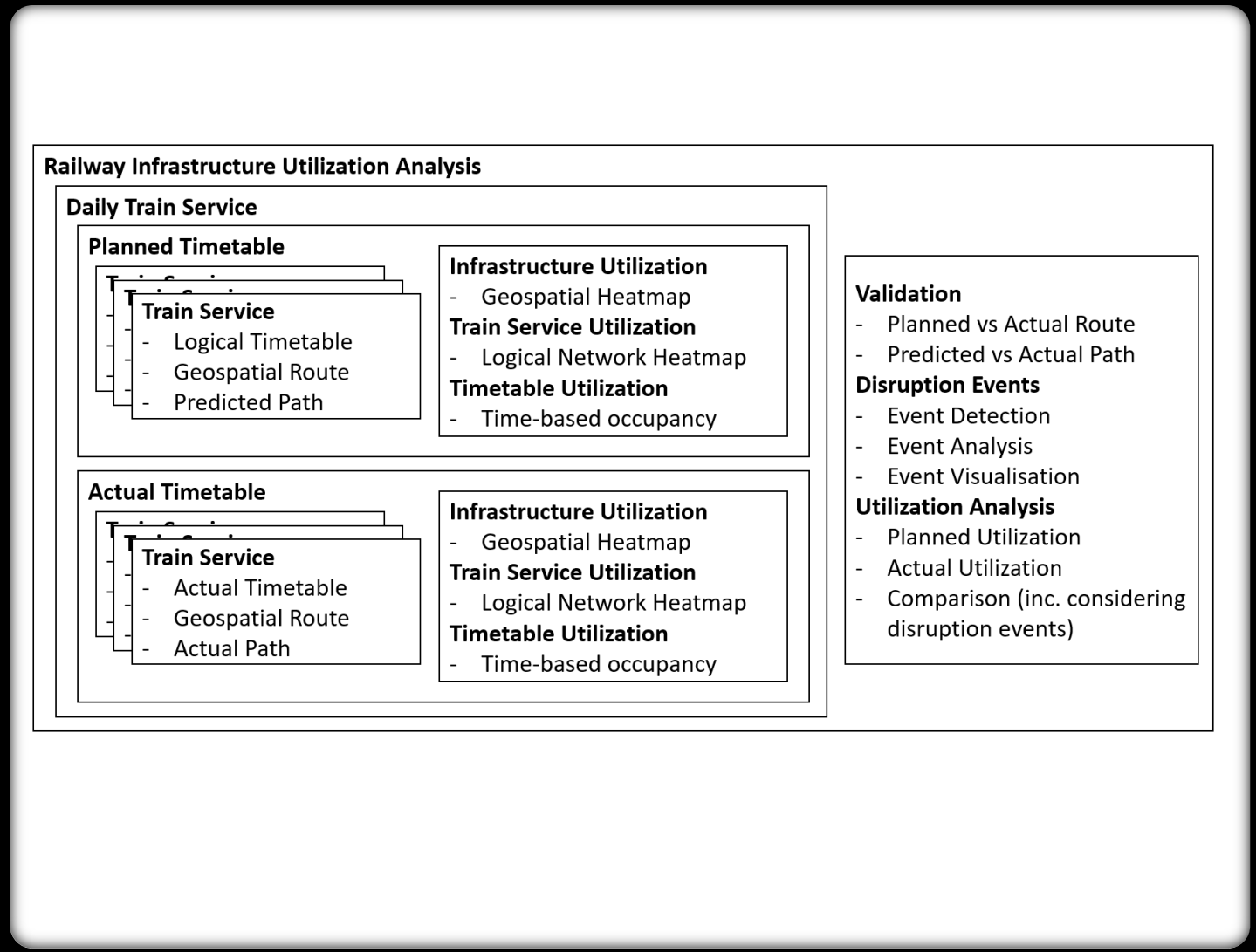
Spatial Temporal Graphs

Identify Differences in Utilisation

Realtime Processing

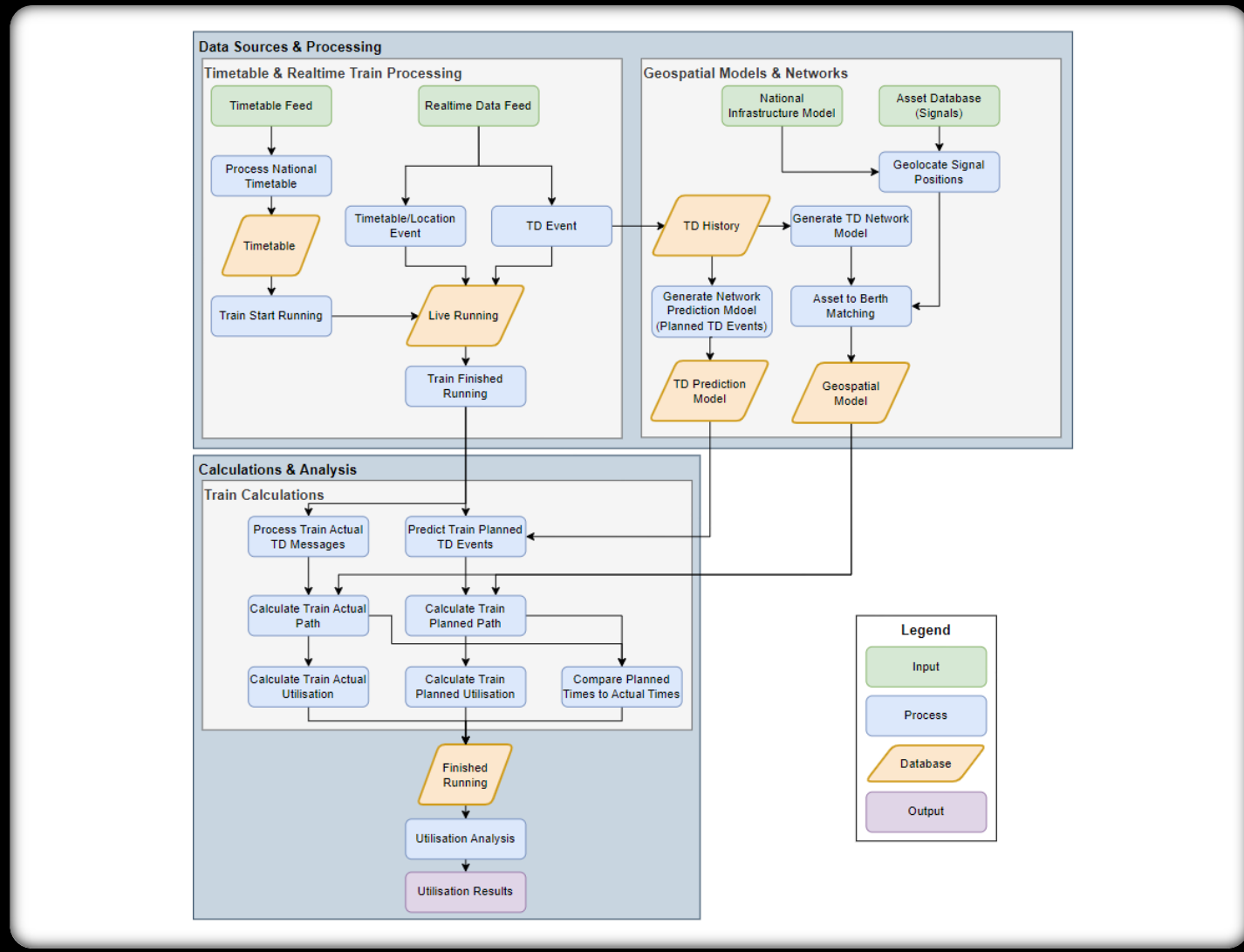
METHODOLOGY

- Data Preparation
- Data Processing
- Calculation



PROCESS

- Data Preparation
- Data Processing
- Calculation



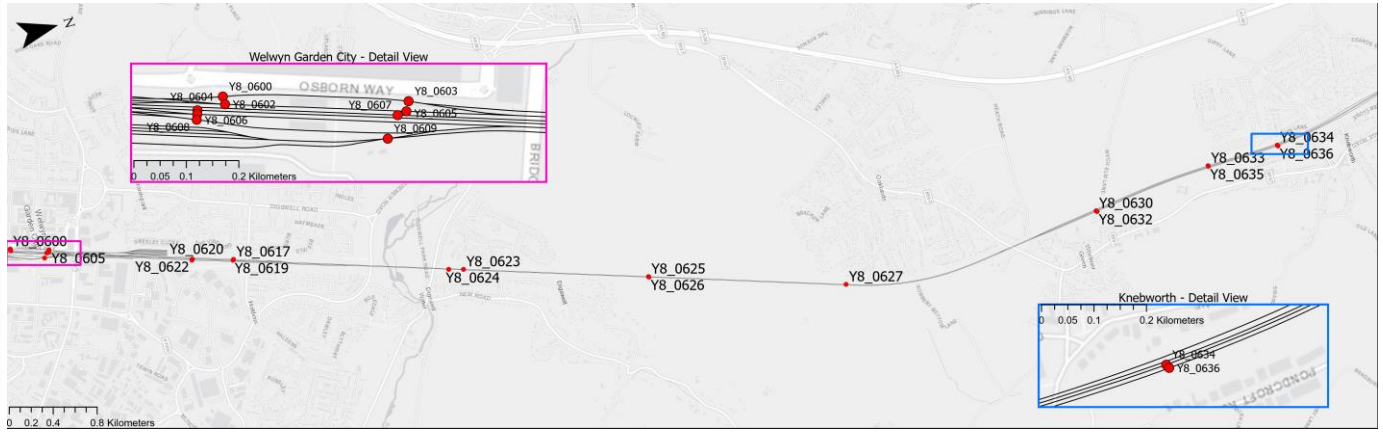
SCOPE

- Over 20,000 Miles
- 15,416 edges

Newcastle University GEOSPATIAL SYSTEMS NetworkRail UKRI UK Research and Innovation

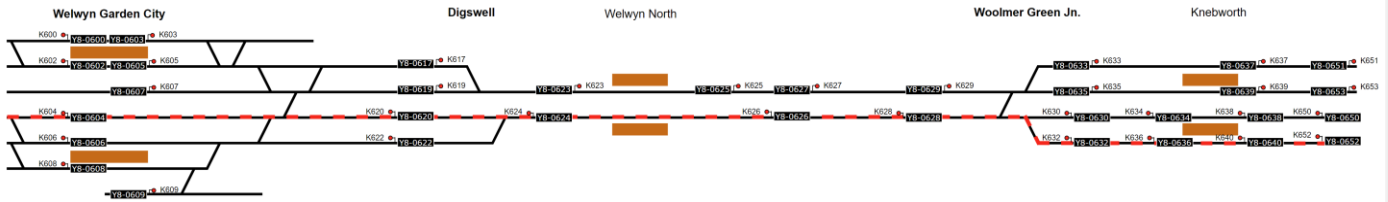
DATA PREPARATION

- Geospatial Model
- Physical Assets



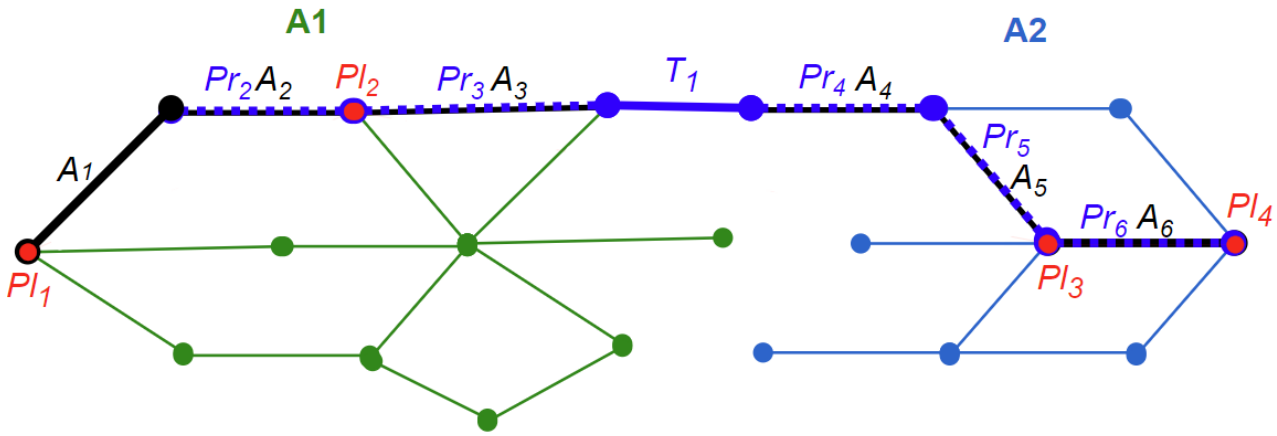
DATA PROCESSING

- Logical Diagram
- Logical Path



DATA PROCESSING

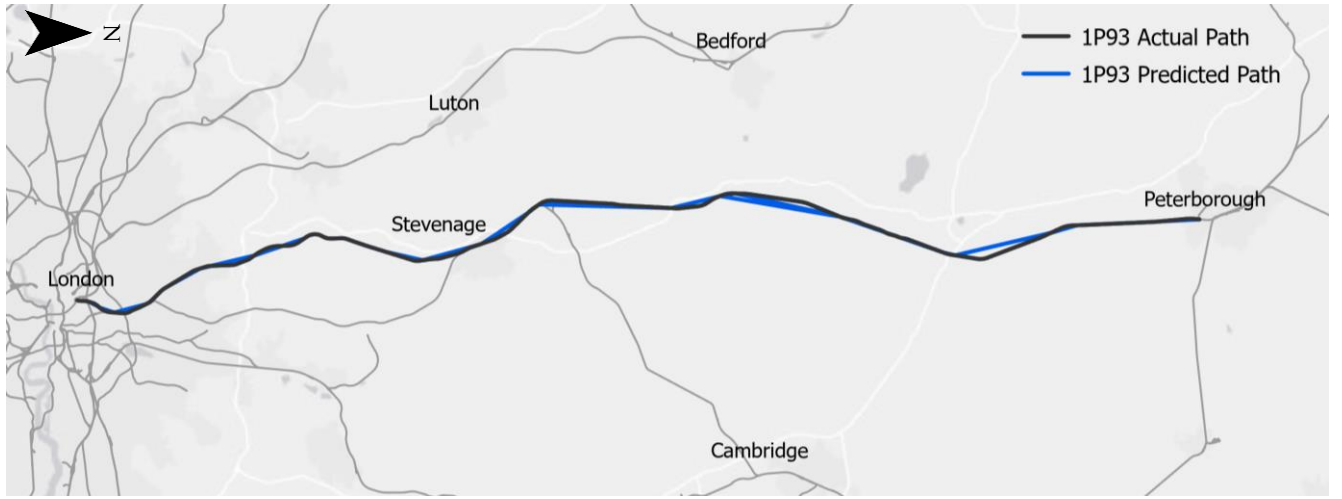
- Actual Network Path
- Predict Planned Path
  - Probabilistic Prediction Model
  - Modal next edge
  - Mean edge duration



A1 A2	Train Describer Networks
A_n	Actual Network Path
Pl_n	Timetabled locations
Pr_n	Predicted Planned Path
T_n	Transitions between Networks

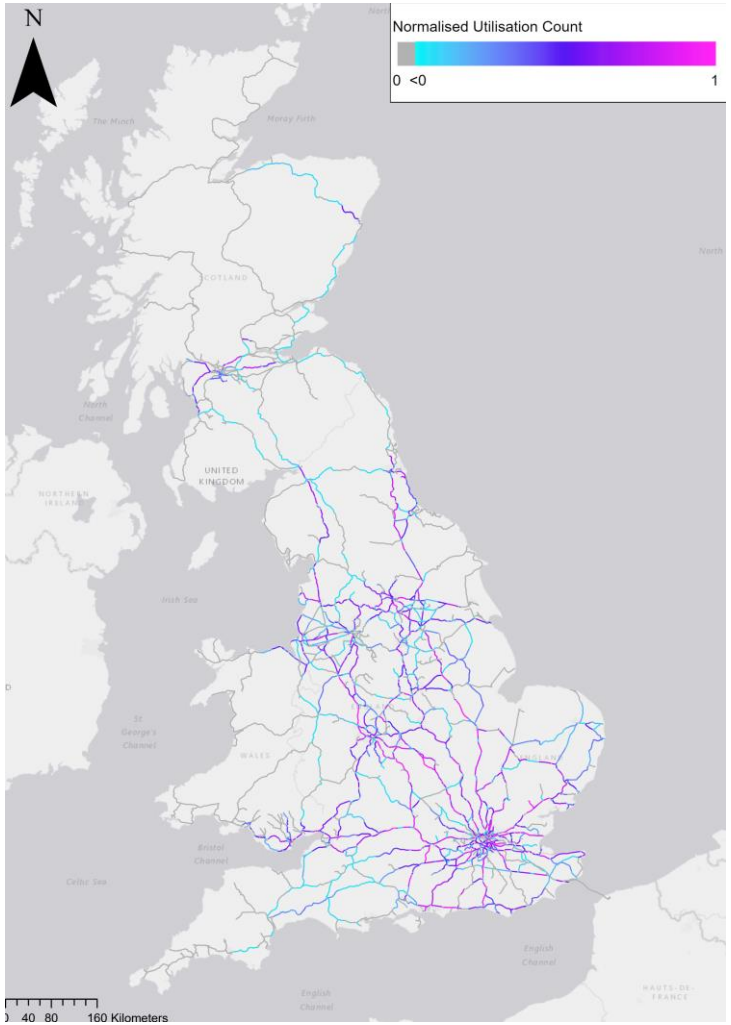
CALCULATION

- Geospatial Route
- Utilisation



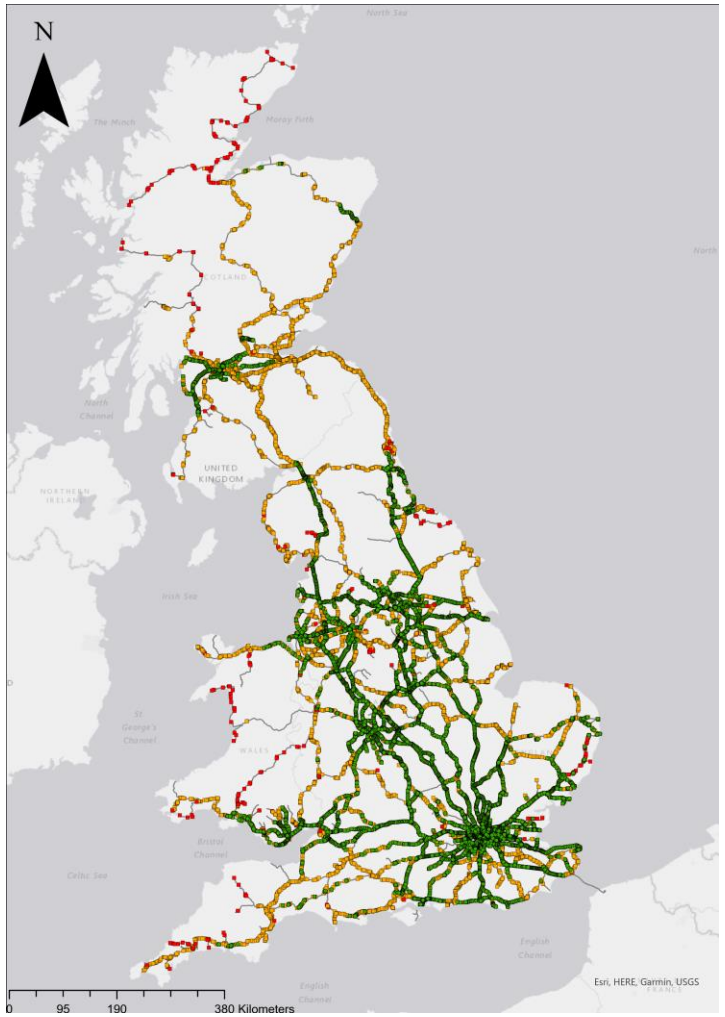
CALCULATION

- Geospatial Route
- Utilisation



CHALLENGES

- Data quality
- Data availability
- Impact of Poor Data



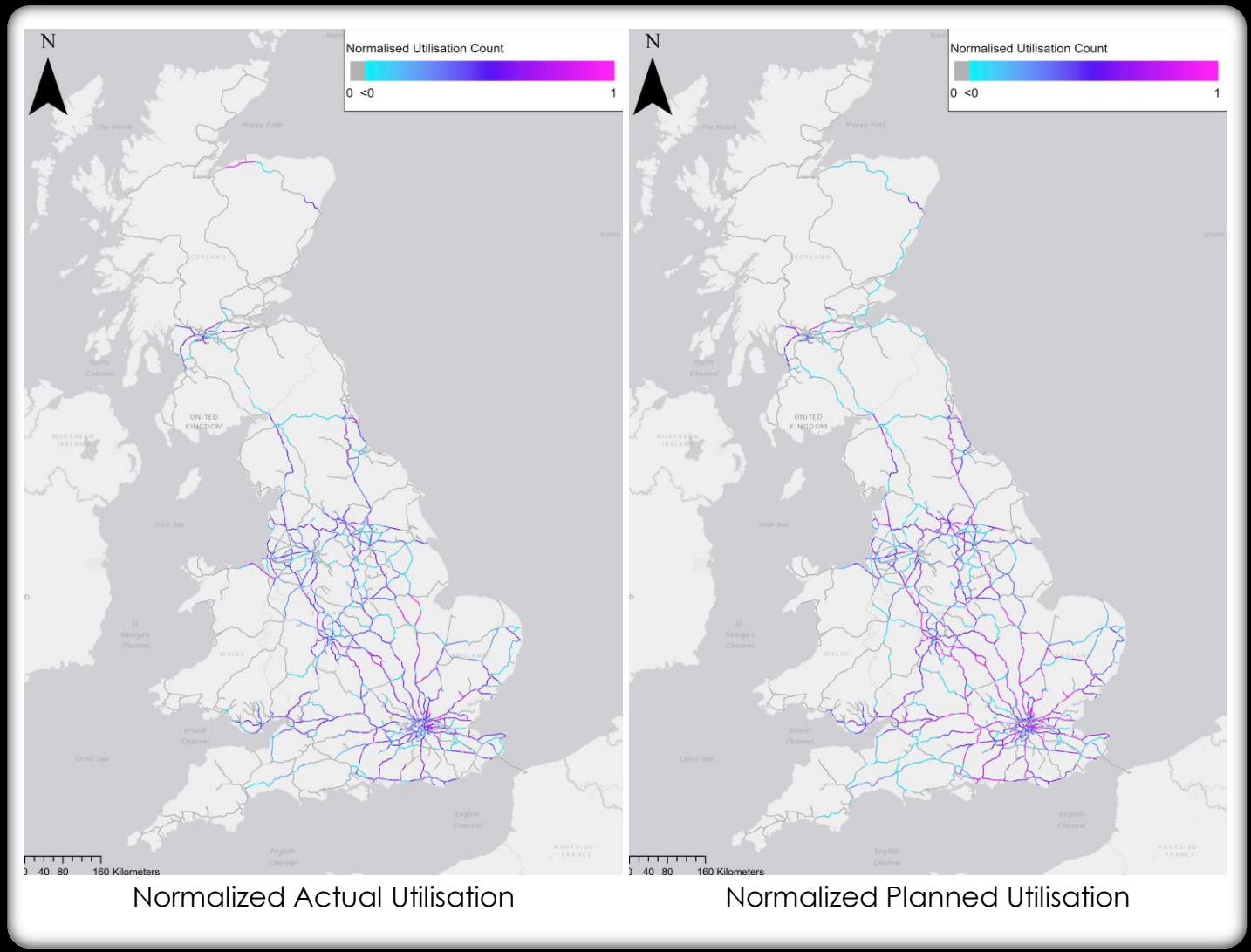
Newcastle University GEOSPATIAL SYSTEMS NetworkRail UKRI UK Research and Innovation

CHALLENGES

- Data quality
- Data availability
- Impact of Poor Data

RESULTS

- 11th to 23rd July 2023
- 26.5 million train movements
- 7.8 million planned locations
- 149,473 out of 181,181 trains successfully calculated (82.50%)

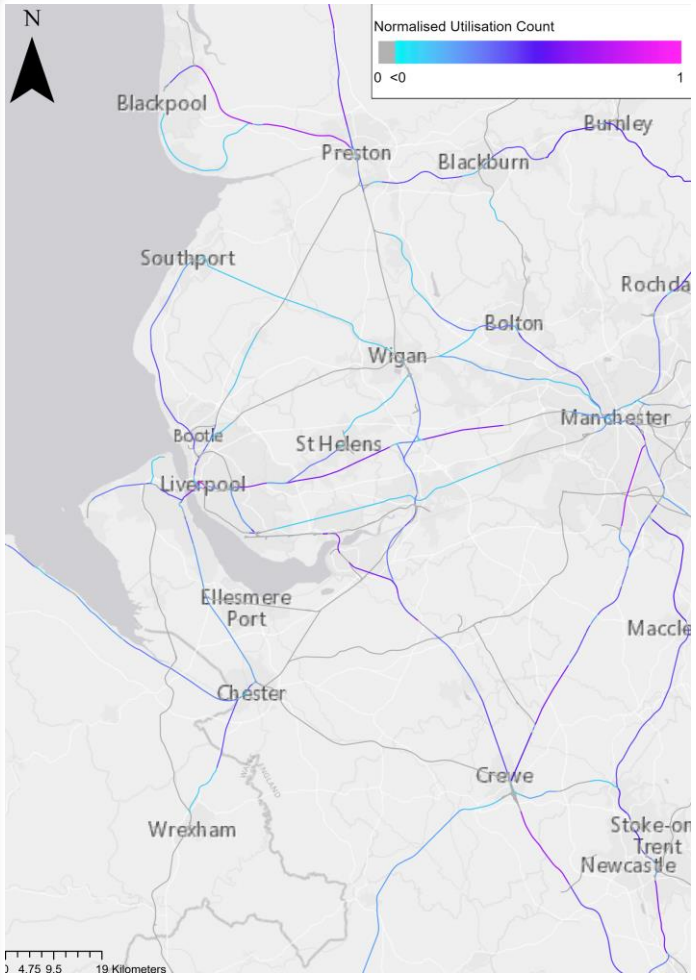


Normalized Actual Utilisation

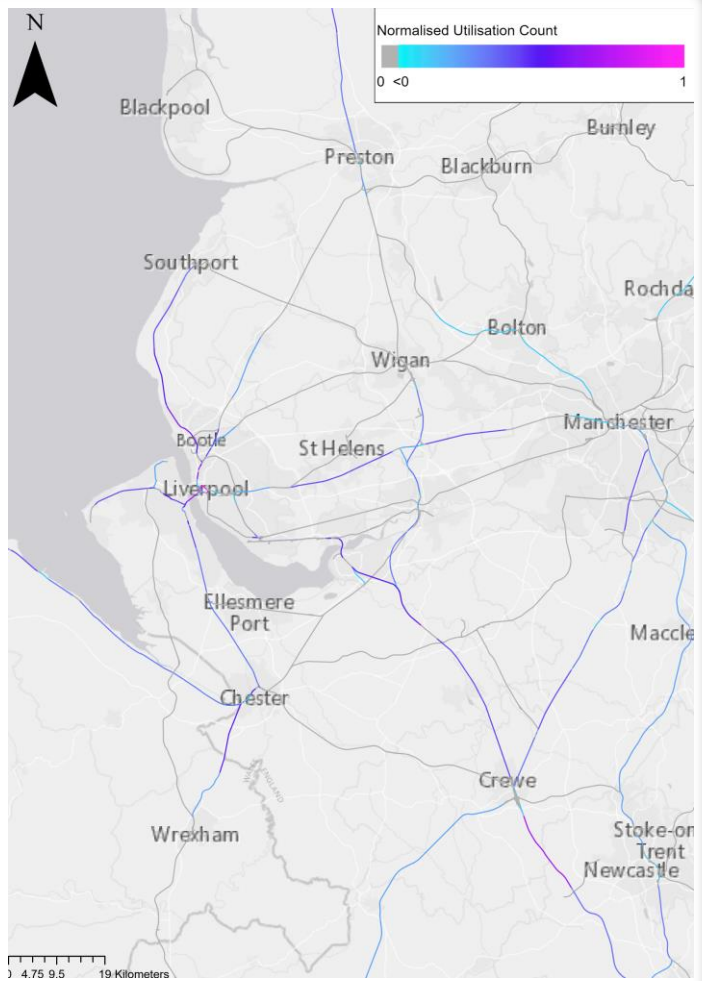
Normalized Planned Utilisation

RESULTS

- Industrial Action 20th July
- On Strike:
  - TransPennine Express
  - Northern
  - Avanti West Coast
- Not On strike:
  - Merseyrail
  - Transport for Wales



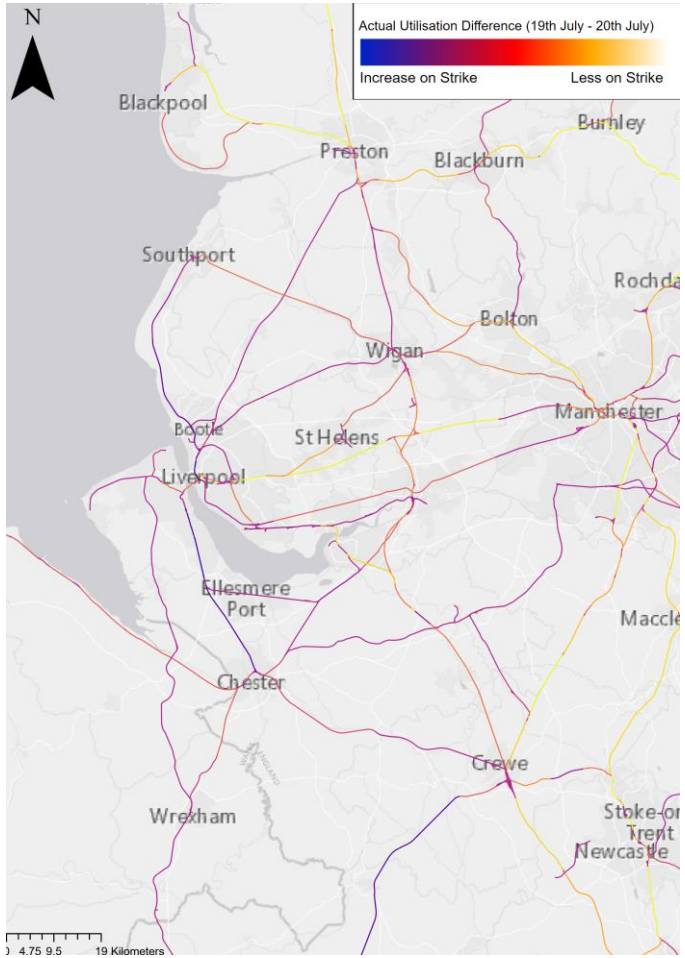
19th July Normalized Actual Utilisation



20th July Normalized Actual Utilisation

RESULTS

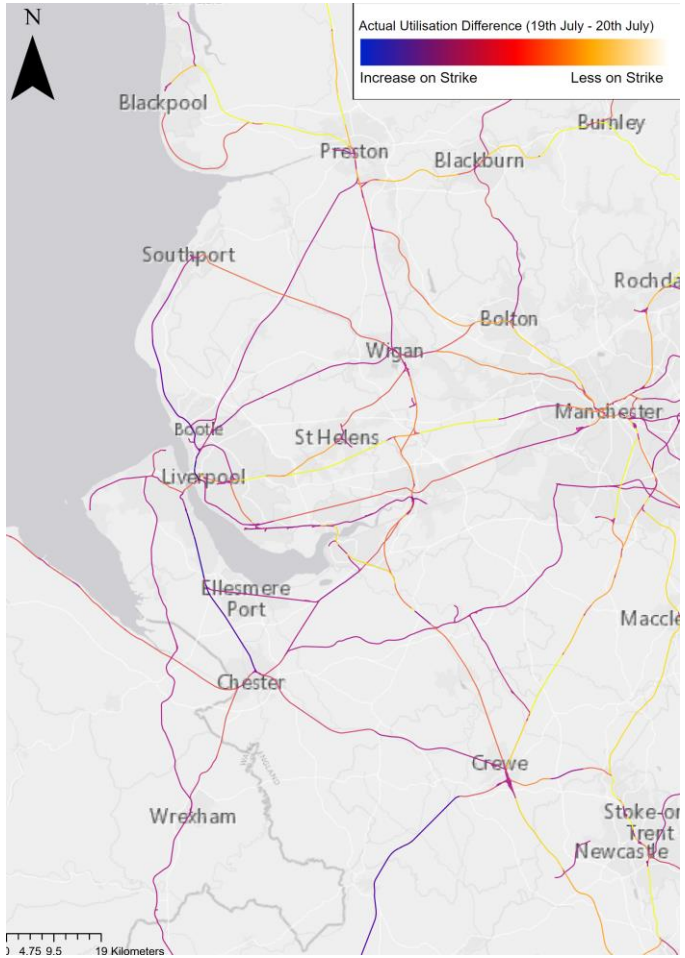
- Industrial Action 20th July
- On Strike:
  - TransPennine Express
  - Northern
  - Avanti West Coast
- Not On strike:
  - Merseyrail
  - Transport for Wales



Actual Difference between 19th & 20th July 2023

CONCLUSIONS

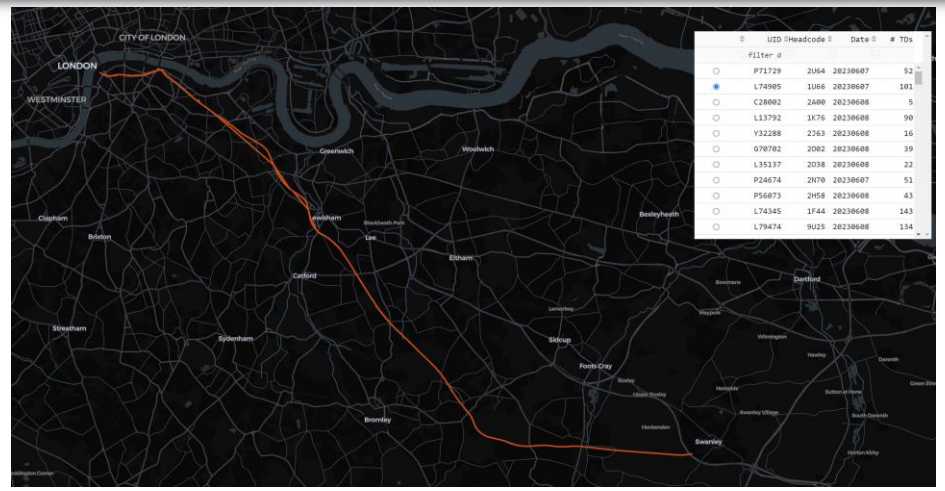
- Method has potential, strike days indicate this
- Currently limited by data quality and availability

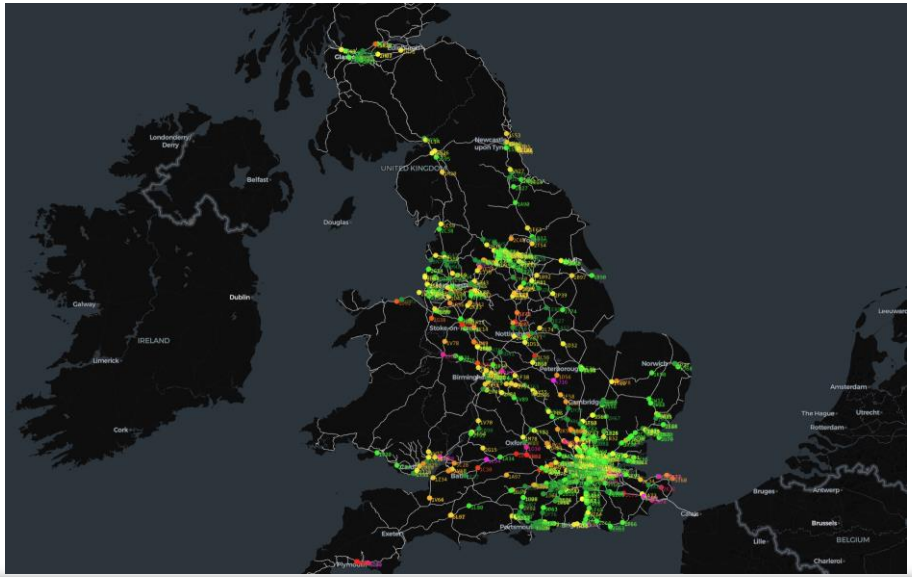


Actual Difference between 19th & 20th July 2023

FURTHER WORK

- Data Quality Improvements
- Utilisation & Capacity Methods
- Realtime
- Incident Detection
  - Historical Analysis
  - Realtime Detection

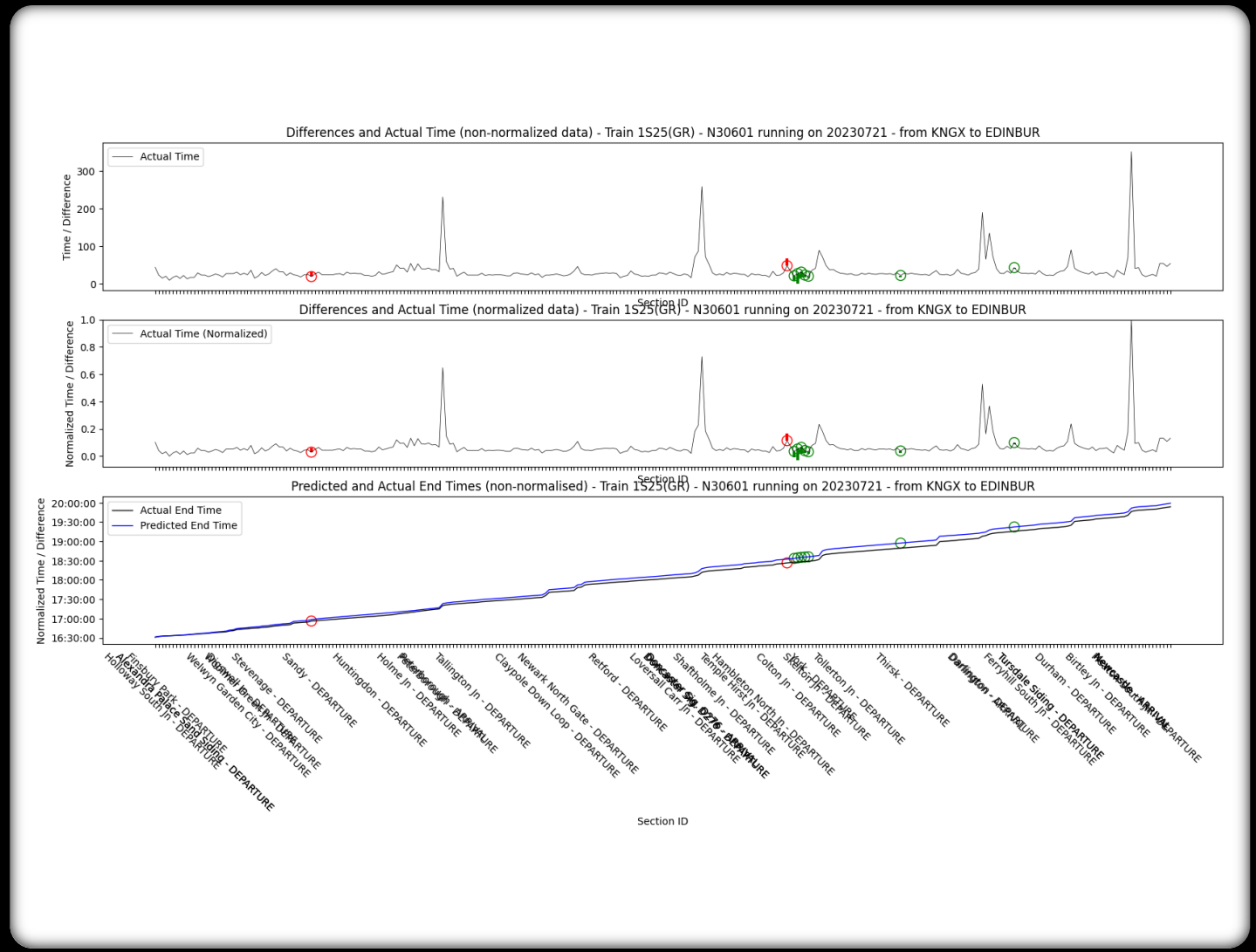




Newcastle University GEOSPATIAL SYSTEMS NetworkRail UKRI UK Research and Innovation

FURTHER WORK

- Data Quality Improvements
- Utilisation & Capacity Methods
- Realtime
- Incident Detection
  - Historical Analysis
  - Realtime Detection



ANALYSING RAILWAY INFRASTRUCTURE UTILISATION
A GEOSPATIAL APPROACH

Any Questions?

Newcastle University GEOSPATIAL SYSTEMS CENTRE FOR DOCTORAL TRAINING NetworkRail UKRI UK Research and Innovation