UNIVERSITY OF BIRMINGHAM

Utilising GPS mapping products to increase the spatial and temporal resolution of traffic data

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NERC SCIENCE OF THE ENVIRONMENT

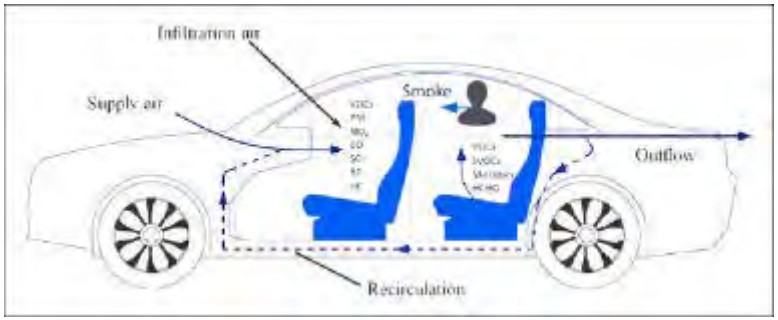
DREAM
DATA, RISK & ENVIRONMENTAL ANALYTICAL METHODS

Overall PhD aim: to improve the integration of transport, emissions, and air quality models in order to produce a more realistic estimation of risk (human exposure to pollutants)

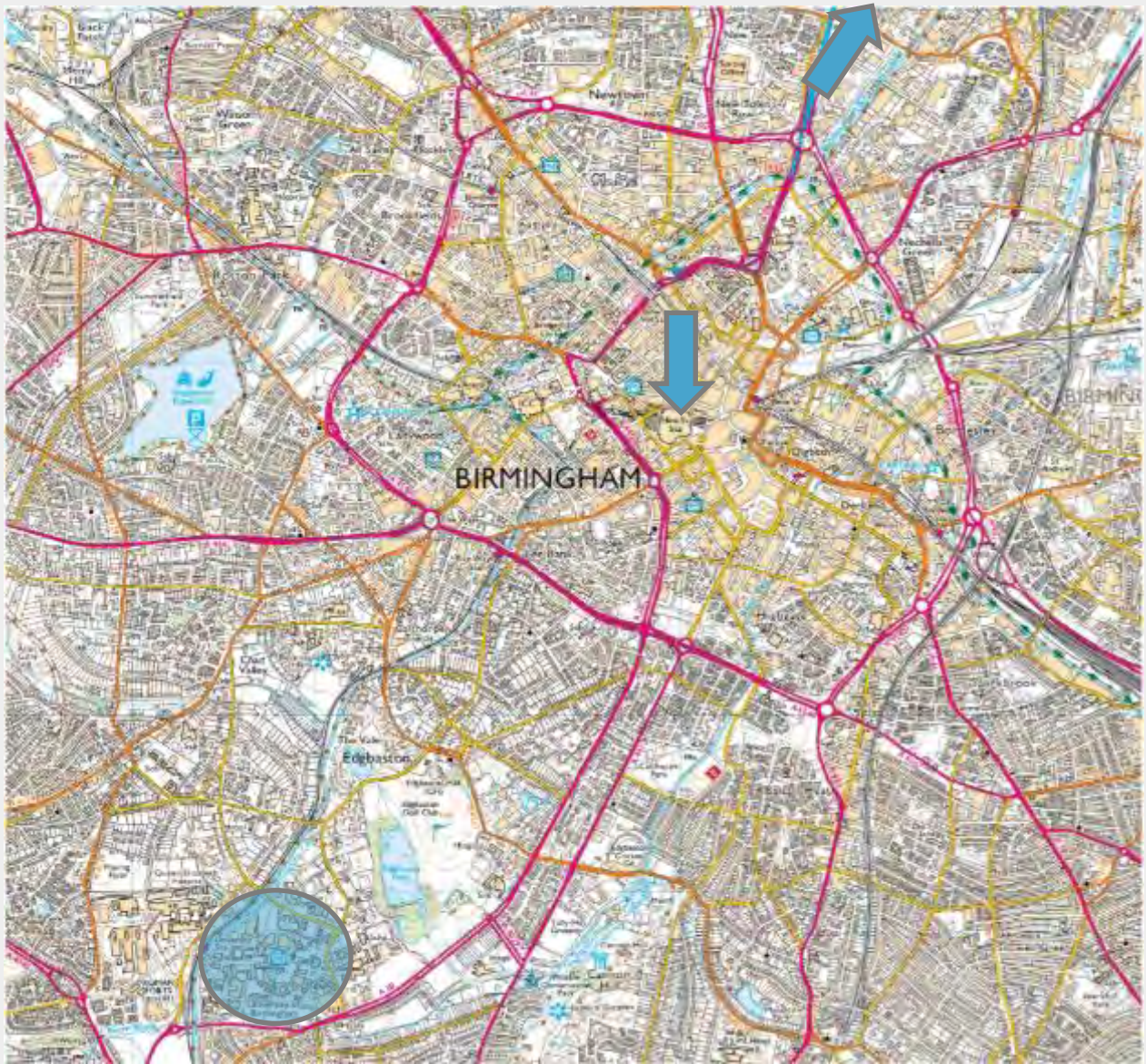
Context: Air Quality

Why is air pollution an issue?

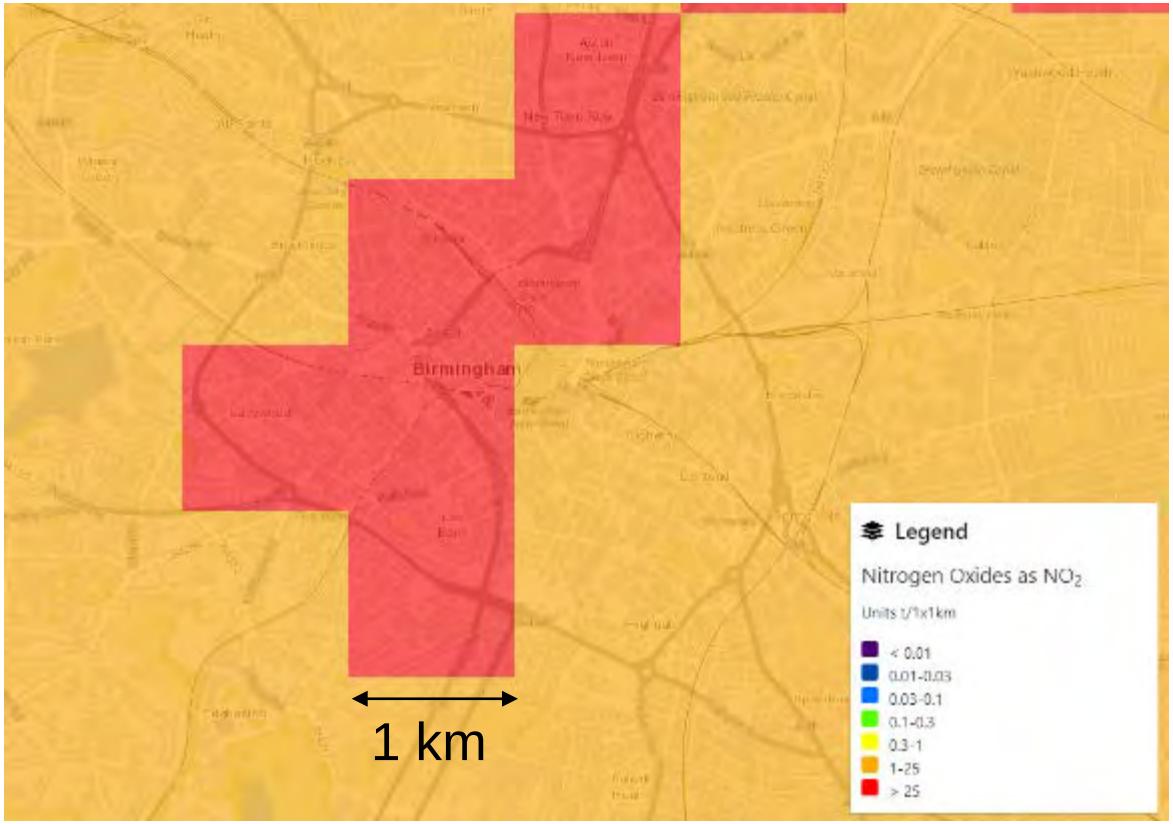
- 40,000 premature deaths and costs £20 billion / year (RCP, 2016)
- Economic burden (health care, declining productivity, environmental degradation) (OECD, 2016)
- Inside car concentrations can be significantly higher than road-side concentrations (Xu et al., 2016)



Context: Birmingham

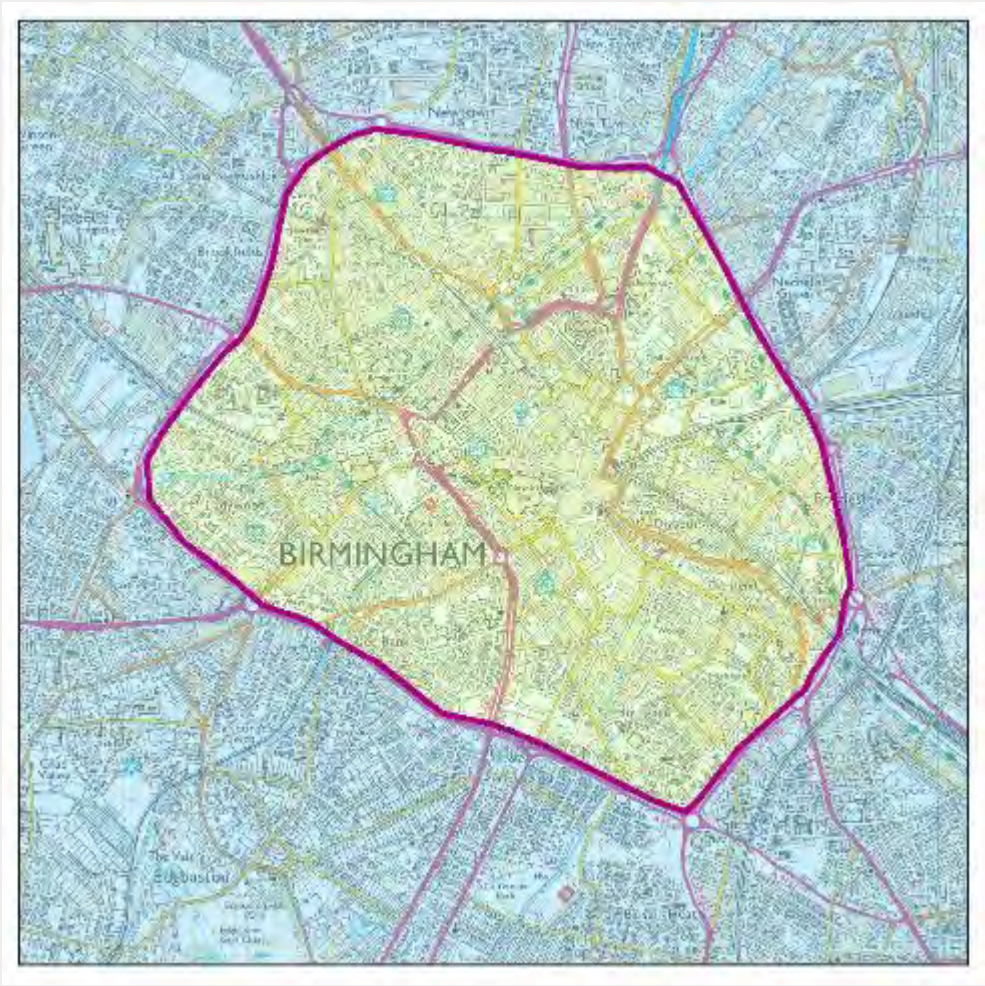


Context: Birmingham Air Quality



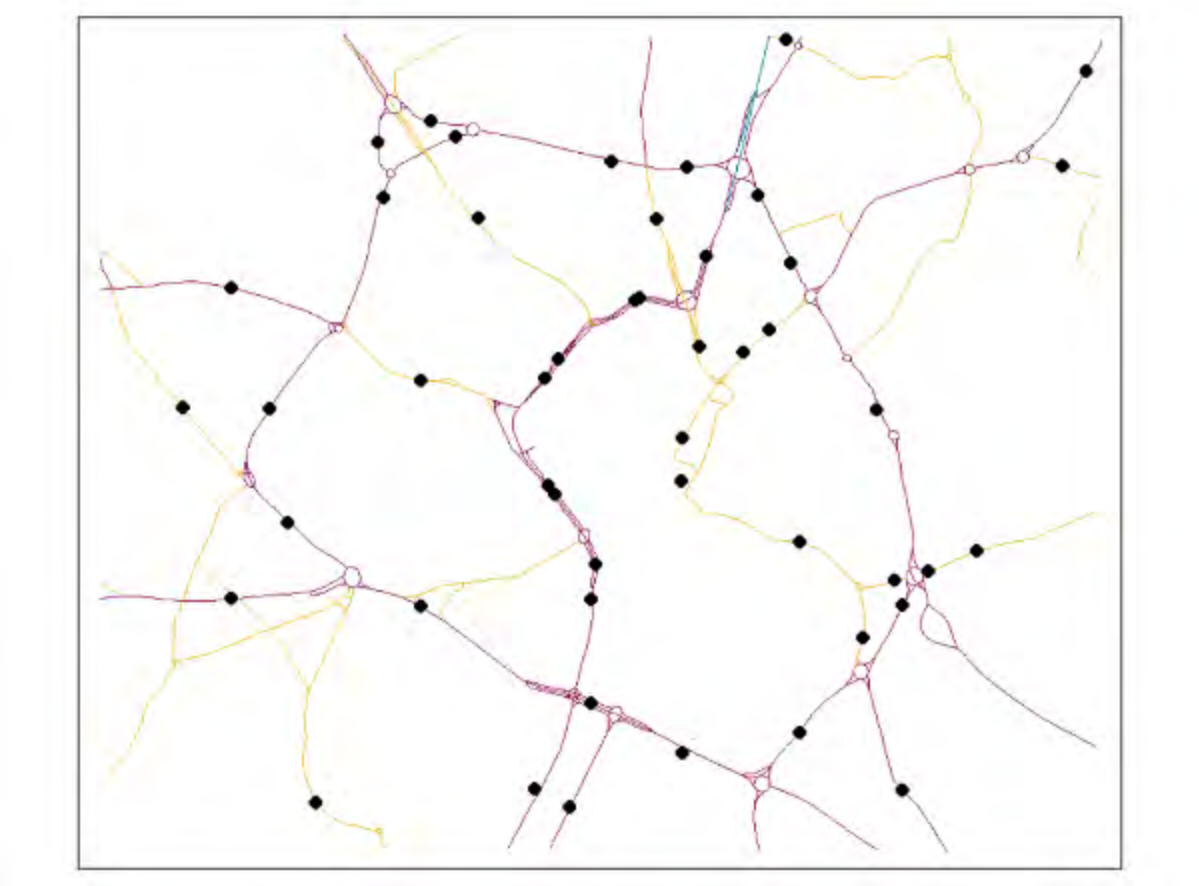
- National Atmospheric Emissions Inventory 2016 data
- NO2 emissions from road transport

Context: Clean Air Zone



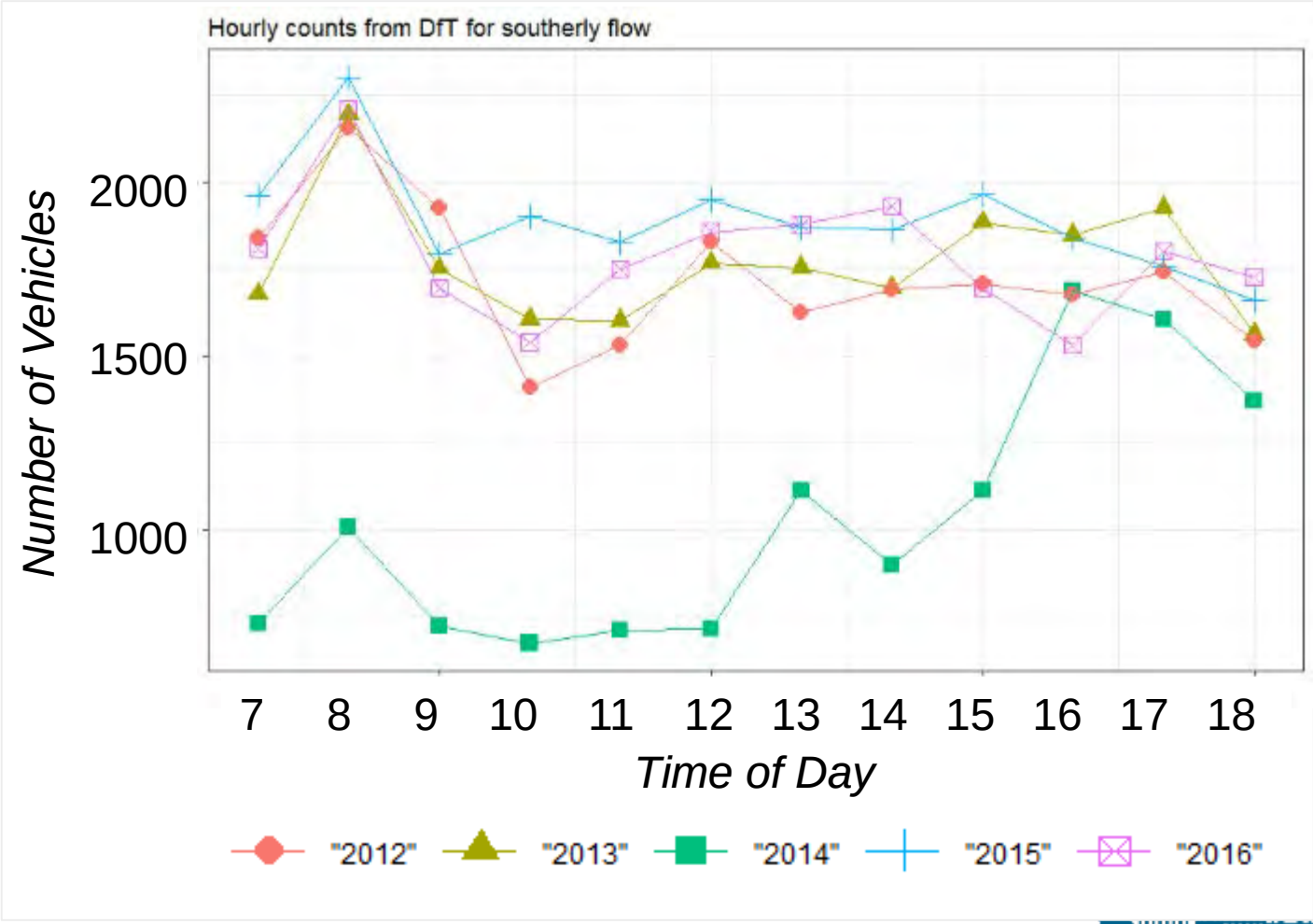
January 2020 → July 2020

Current state of traffic data



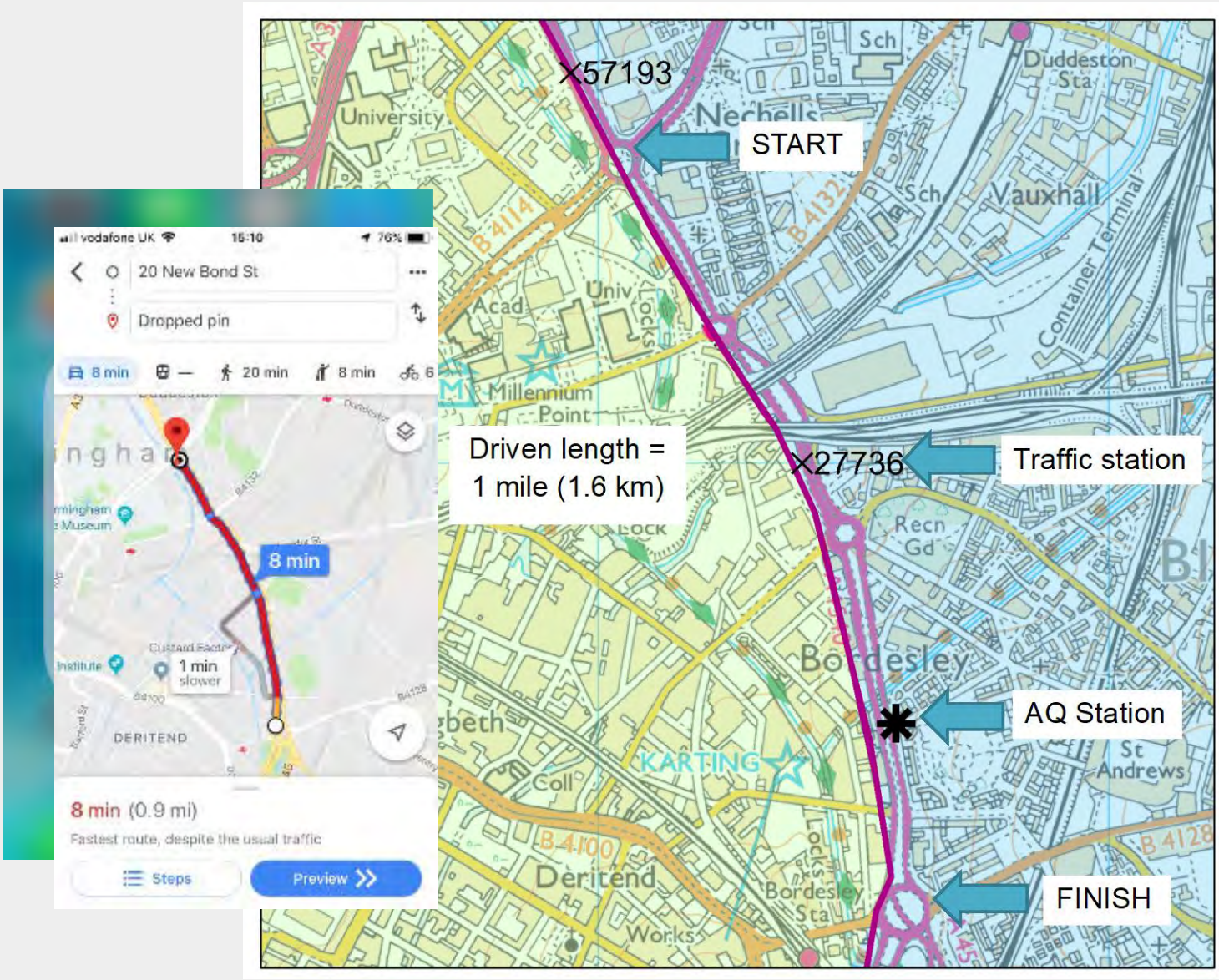
Department for Transport count point locations

Current state of traffic data



- 1 day per year
- Hourly totals
- 7am -7pm
- Incomplete for other stations

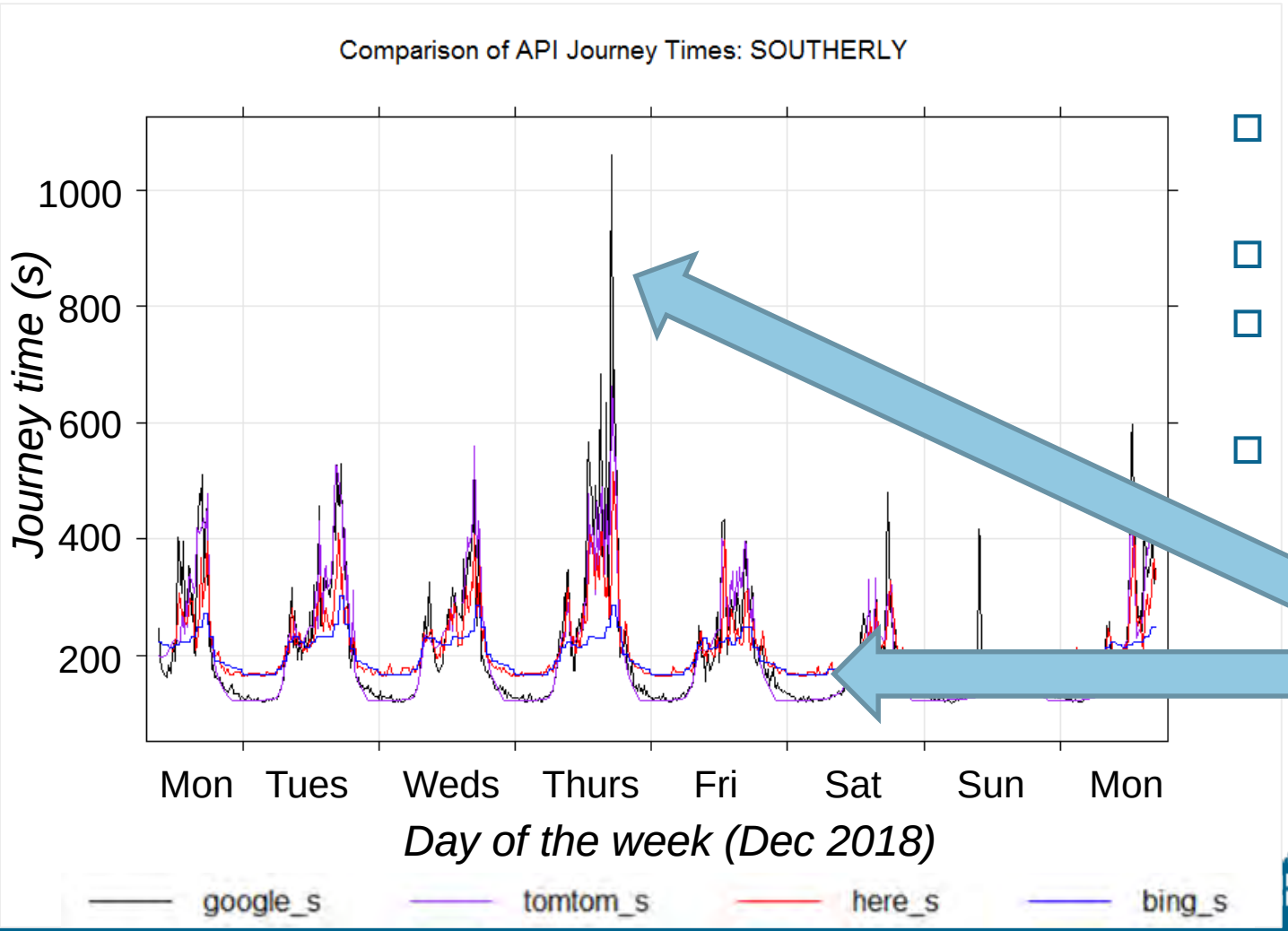
Use of mapping products in isolation



URL Example

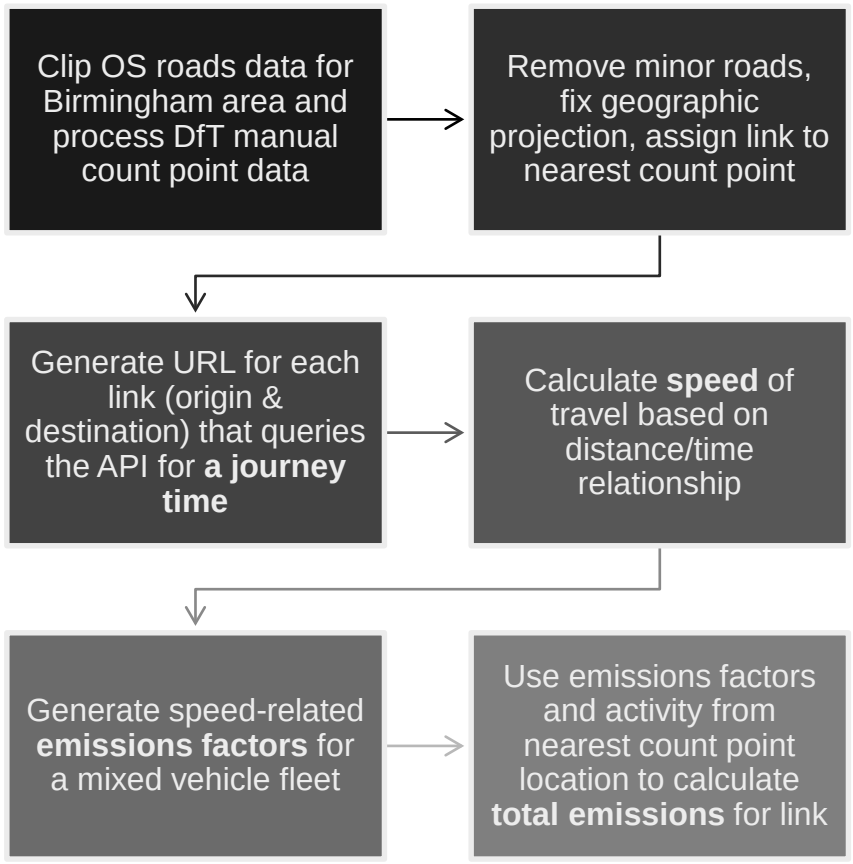
https://{"response":{"metaInfo":{"timestamp":"2019-06-18T13:31:49Z","mapVersion":"8.30.97.151","moduleVersion":"7.2.201923-3839","interfaceVersion":"2.6.58","availableMapVersion":["8.30.97.151"]},"route":[{"waypoint":[{"linkId":"-26344279","mappedPosition":{"latitude":52.4679071,"longitude":-1.9038641},"originalPosition":{"latitude":52.4678768,"longitude":-1.9038784},"type":"stopOver","spot":0.377551,"sideOfStreet":"right","mappedRoadName":"Lee Bank Middleway","label":"Lee Bank Middleway","shapeIndex":0,"source":"user"},{"linkId":"-1000175855","mappedPosition":{"latitude":52.4677612,"longitude":-1.9029082},"originalPosition":{"latitude":52.4677232,"longitude":-1.9029219},"type":"stopOver","spot":0.1142857,"sideOfStreet":"right","mappedRoadName":"Lee Bank Middleway","label":"Lee Bank Middleway","shapeIndex":2,"source":"user"}],"mode":{"type":"fastest","transportModes":["car"],"trafficMode":"enabled","feature":[]},"leg":[{"start":{"linkId":"-26344279","mappedPosition":{"latitude":52.4679071,"longitude":-1.9038641},"originalPosition":{"latitude":52.4678768,"longitude":-1.9038784},"type":"stopOver","spot":0.377551,"sideOfStreet":"right","mappedRoadName":"Lee Bank Middleway","label":"Lee Bank Middleway","shapeIndex":0,"source":"user"},"end":{"linkId":"-1000175855","mappedPosition":{"latitude":52.4677612,"longitude":-1.9029082},"originalPosition":{"latitude":52.4677232,"longitude":-1.9029219},"type":"stopOver","spot":0.1142857,"sideOfStreet":"right","mappedRoadName":"Lee Bank Middleway","label":"Lee Bank Middleway","shapeIndex":2,"source":"user"},"length":75,"travelTime":7,"maneuver":[{"position":{"latitude":52.4679071,"longitude":-1.9038641},"instruction":"Take ramp onto <span class=\"next-street\">Lee Bank Middleway. <span class=\"distance-description\">Go for <span class=\"length\">71 m.","travelTime":7,"length":71,"id":"M1","_type":"PrivateTransportManeuverType"},{"position":{"latitude":52.4677612,"longitude":-1.9029082},"instruction":"Arrive at <span class=\"street\">Lee Bank Middleway. Your destination is on the right.","travelTime":0,"length":4,"id":"M2","_type":"PrivateTransportManeuverType"}]}],"summary":{"distance":75,"trafficTime":7,"baseTime":6,"flags":["builtUpArea"],"text":"The trip takes <span class=\"length\">75 m and less than <span class=\"time\">1 min.","travelTime":7,"_type":"RouteSummaryType"}}],"language":"en-us"}}

Comparison of mapping products



- Greater temporal resolution
- Cheaper
- Less labour-intensive
- Greater temporal coverage

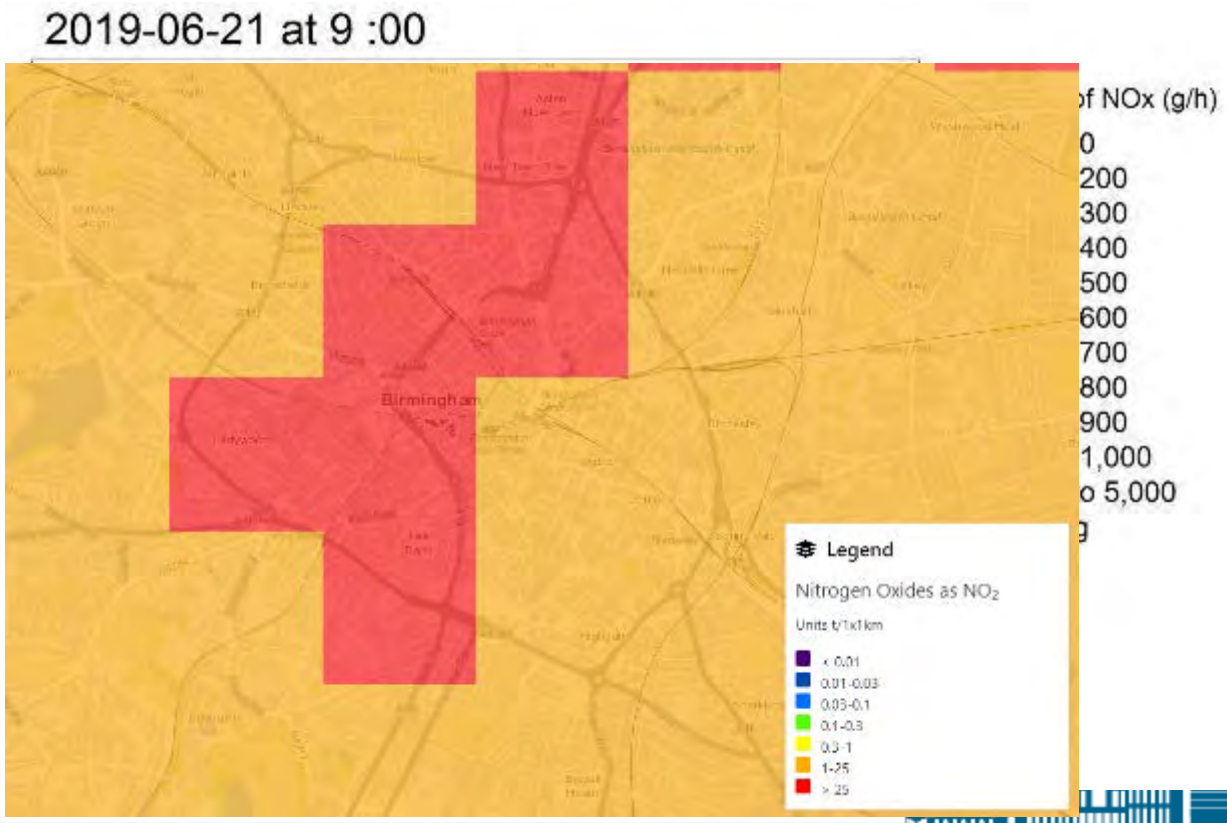
Application of mapping products over Birmingham area: workflow



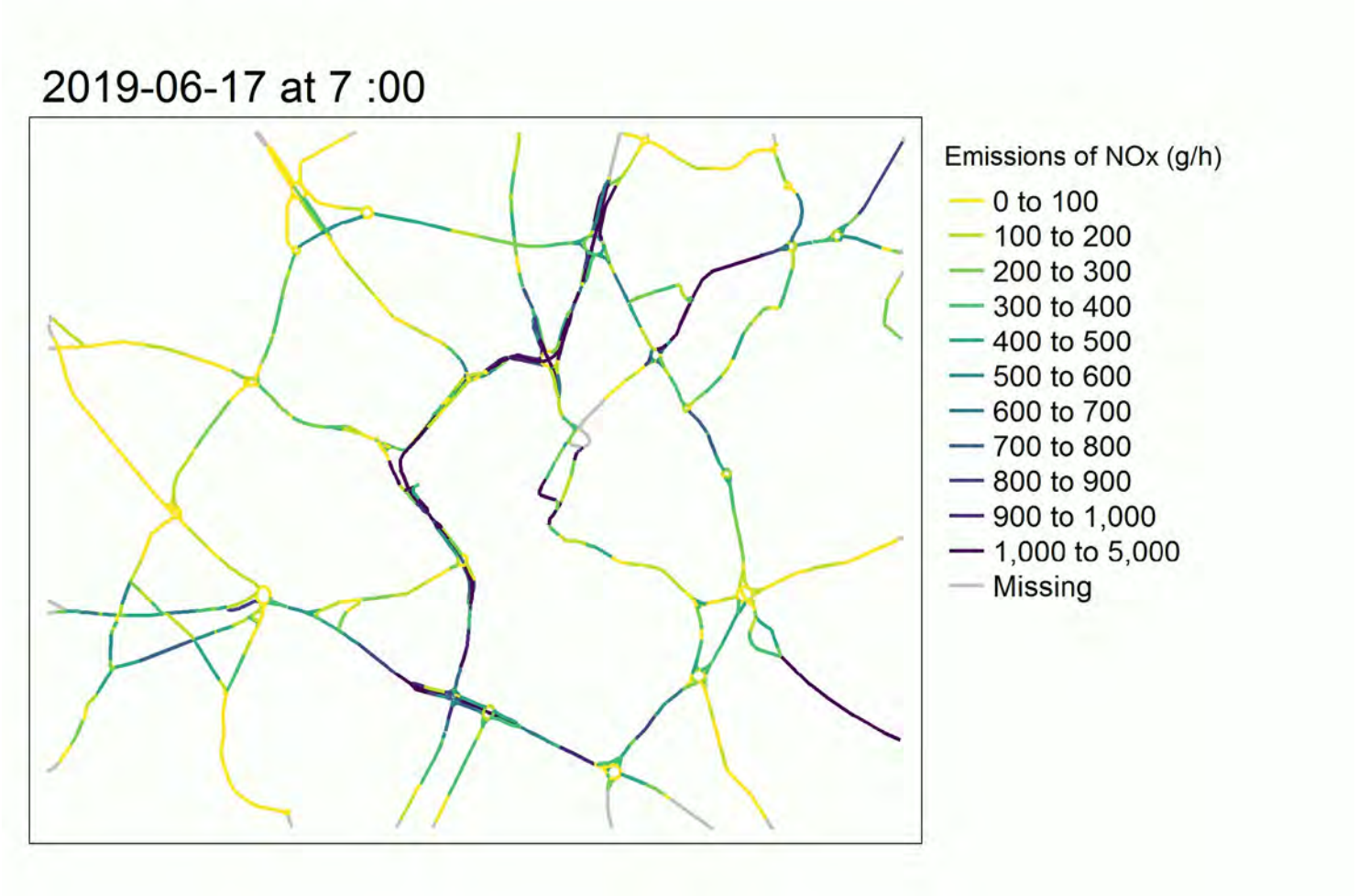
Application across Birmingham area

6: Use emissions factors and activity from nearest count point location to calculate total emissions for link

Total emission (g/h) = Emission Factor (g) * Activity (vehicles/hour)



And repeat...


2019-06-17 at 7 :00
Emissions of NOx (g/h)
0 to 100
100 to 200
200 to 300
300 to 400
400 to 500
500 to 600
600 to 700
700 to 800
800 to 900
900 to 1,000
1,000 to 5,000
Missing

Future Work

- Explore additional step of how emissions interact with environment (dispersion and chemical reactions)
- Sensitivity tests:
  - what if 100% of vehicle fleet was petrol?
  - what if all cars could travel at speed limit?
  - what impact could the CAZ have on the ring road?
- Improve traffic activity data – Newcastle Urban Observatory

Thank You & Questions

Scan the above with your camera to view my webpage

Application across Birmingham area

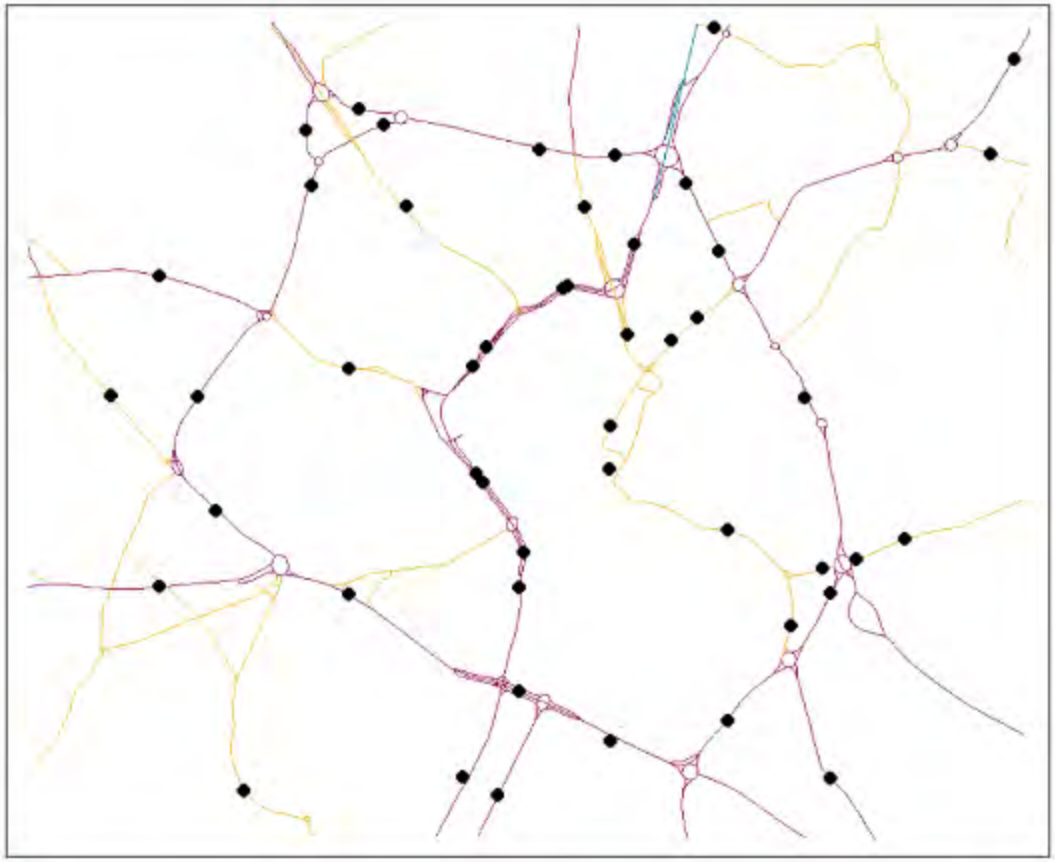
1: Clip OS roads data for Birmingham area and process DfT manual count point data

- OS open roads available for all of UK (April 2019)
- ‘Zoom in’ to area of interest
- Background work completed to ensure most recent year of data for each manual traffic count point was used

Application across Birmingham area

2: Remove minor roads, fix geographic projection, assign link to nearest count point

- Minor roads removed due to usage limits of API (HERE = 250,000 per month)
- Assigned each link to its nearest count point ID



Application across Birmingham area

4: Calculate speed of travel based on distance/time relationship

- Known link length and journey time, therefore:

speed = distance/time

5: Generate speed-related emissions factors for a mixed vehicle fleet

- Traffic fleet composition from nearest count point gives details on: motorbikes, passenger cars, buses, LGVs and HGVs