

**MAGIC**

Envisaging a world with greener cities

# LSBU study

## - September 2019

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# Overview

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- Field study
- Initial results
- Further work



# Field study in London (2-weeks, September 2019)

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- Data collection
- Outdoor and indoor sensors
- Cameras

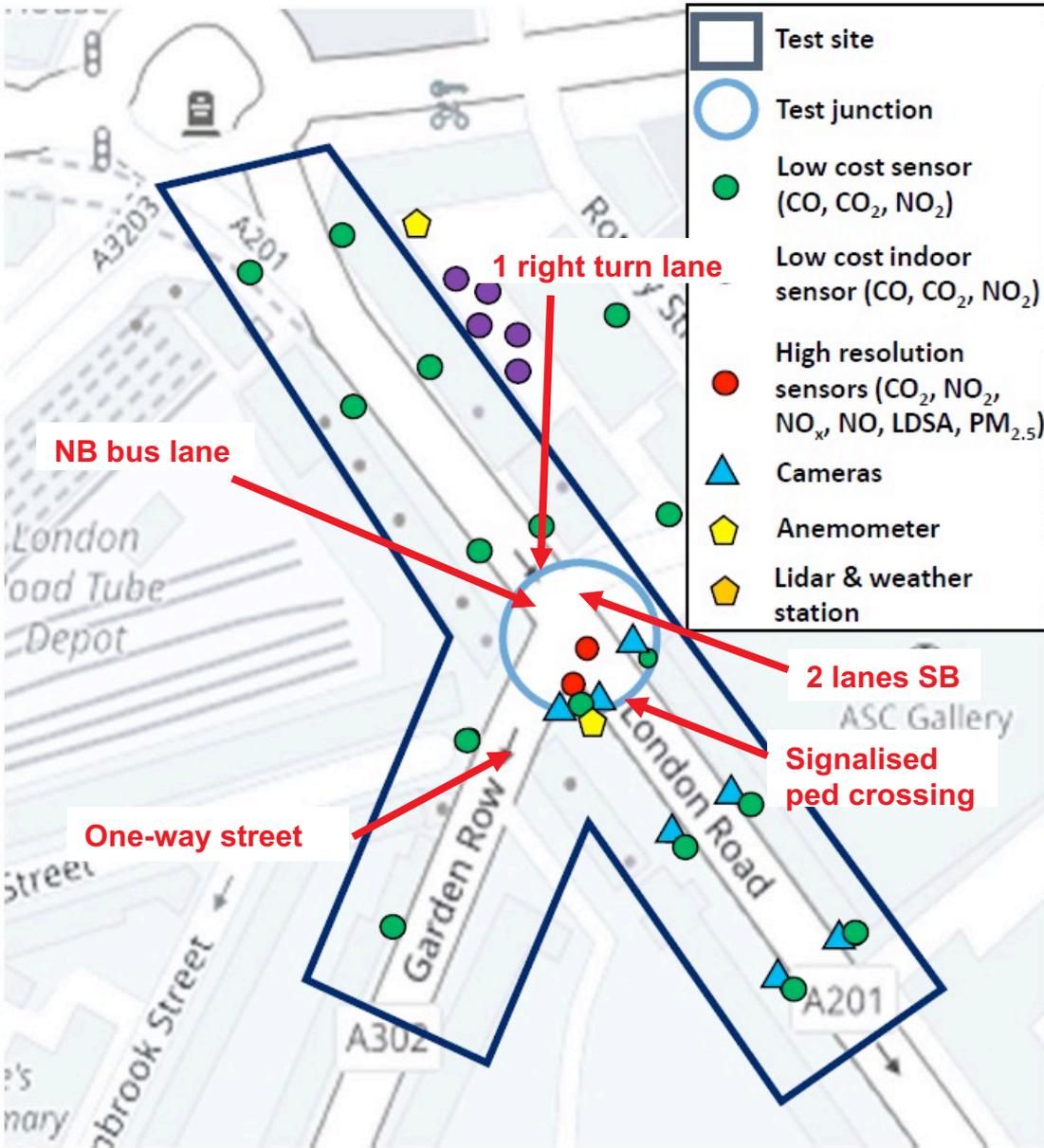
## TfL traffic signal study

- Impact of traffic signal changes on roadside air pollution

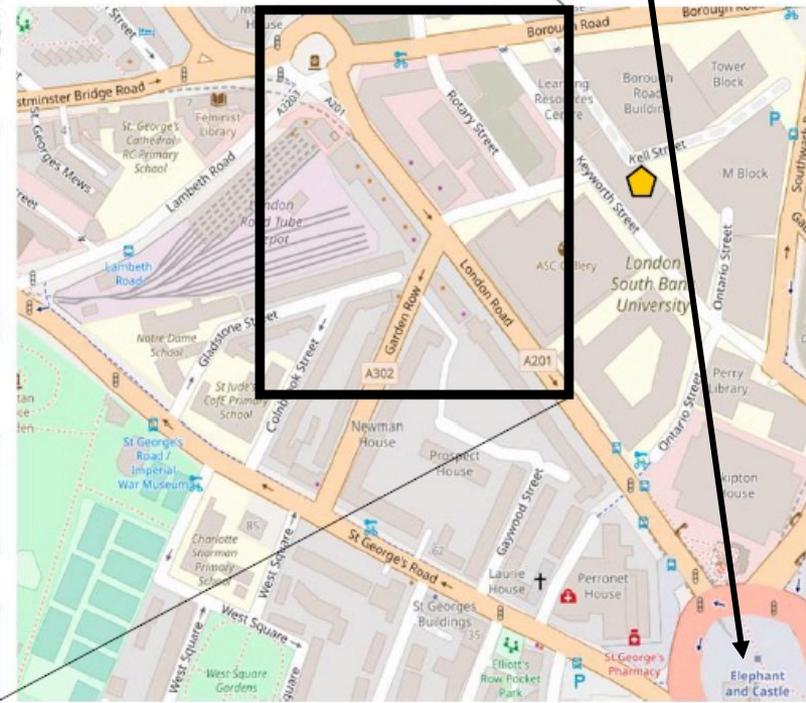


# Field study location

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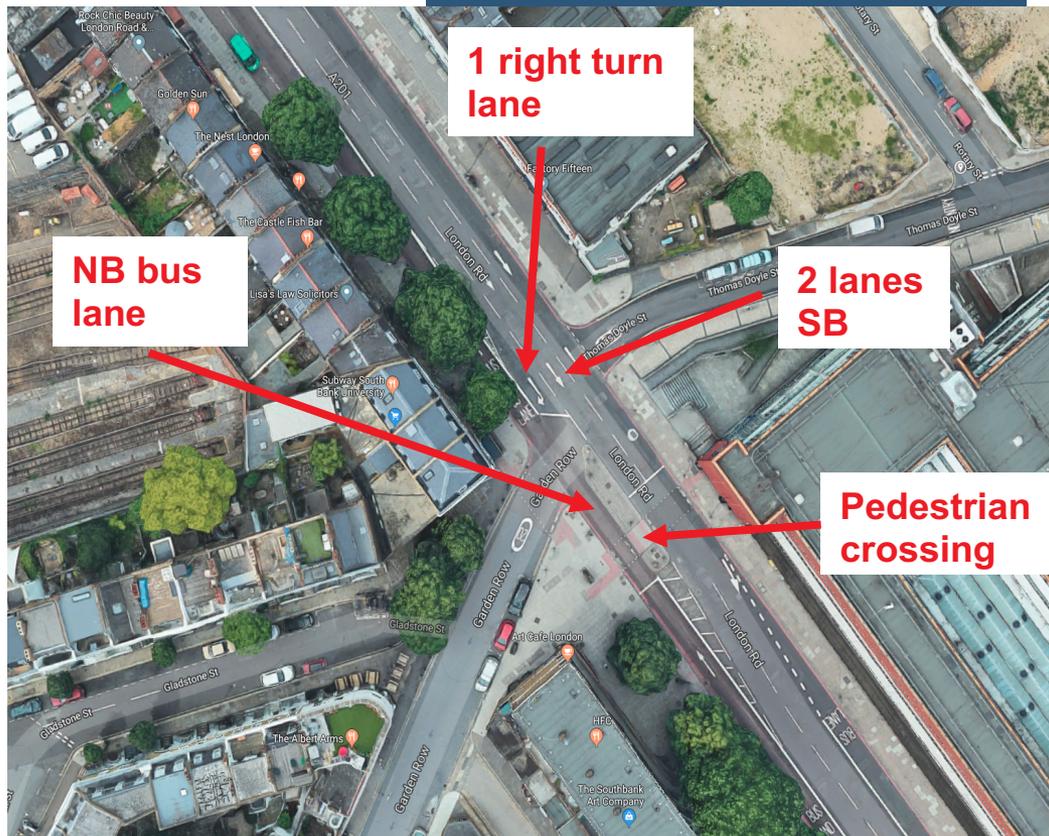
Elephant & Castle – South London



# Effects of traffic signal changes

- Improved traffic flow → reduced emissions?
- Test different traffic signal timings
- TfL doubled cycle time at junction

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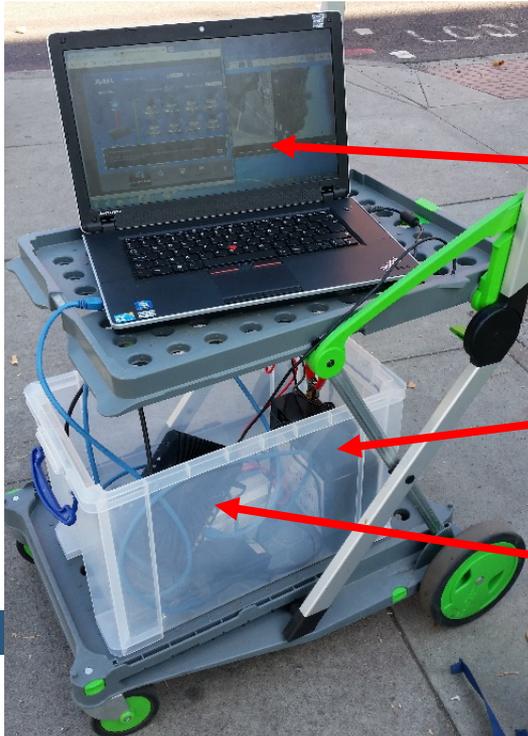
### % of green time for each movement

Movement	48 s cycle (normal)		96 s cycle (intervention)	
Southbound	30 s	62.5 %	62 s	64.5 %
Bus lane	8 s	16.7 %	54 s	56.2 %
Right turn	29 s	60.4 %	30 s	31.2 %
Pedestrian	8 s	16.7 %	11 s	11.5 %

# Cameras



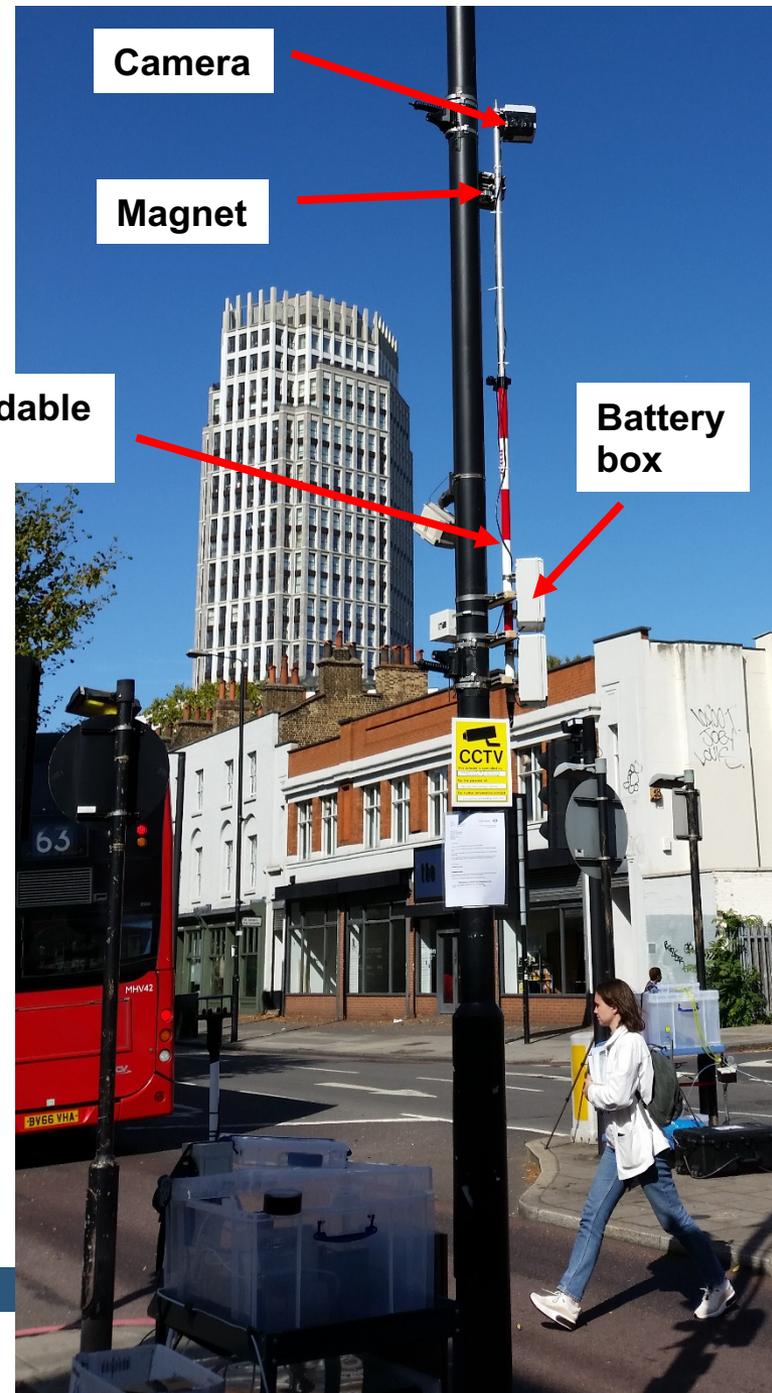
Tripods for number plate information



Laptop to communicate with cameras

Battery for router

Router



Camera

Magnet

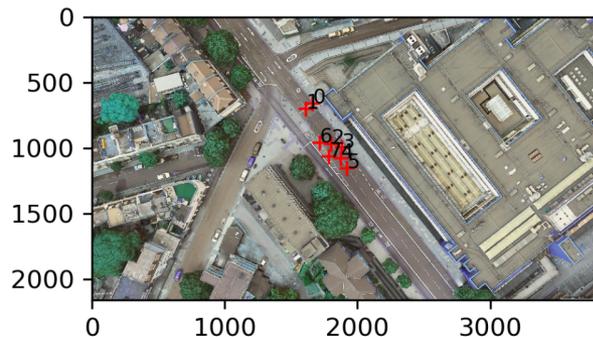
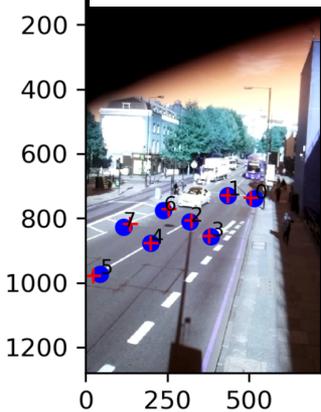
Extendable pole

Battery box

# Computer Vision script

- 7 cameras along London Road
- Used YOLOv3 (pre-trained CNN)
- Mapped camera pixels to world coordinate system (CameraTransform)
- Extracted raw vehicle trajectories and counts from ~260 hours of video footage

0 Mapping from camera to real world coordinates



<b>NBf All: 0</b>	<b>RTf All: 0</b>	<b>SBLf All: 1</b>	<b>SBRf All: 0</b>
NBf Car: 0	RTf Car: 0	SBLf Car: 1	SBRf Car: 0
NBf HGV: 0	RTf HGV: 0	SBLf HGV: 0	SBRf HGV: 0
NBf Bus: 0	RTf Bus: 0	SBLf Bus: 0	SBRf Bus: 0
NBf Mbike: 0	RTf Mbike: 0	SBLf Mbike: 0	SBRf Mbike: 0
NBf Bicycle: 0	RTf Bicycle: 0	SBLf Bicycle: 0	SBRf Bicycle: 0

<b>NBb All: 0</b>	<b>RTb All: 0</b>	<b>SBLb All: 1</b>	<b>SBRb All: 0</b>
NBb Car: 0	RTb Car: 0	SBLb Car: 1	SBRb Car: 0
NBb HGV: 0	RTb HGV: 0	SBLb HGV: 0	SBRb HGV: 0
NBb Bus: 0	RTb Bus: 0	SBLb Bus: 0	SBRb Bus: 0
NBb Mbike: 0	RTb Mbike: 0	SBLb Mbike: 0	SBRb Mbike: 0
NBb Bicycle: 0	RTb Bicycle: 0	SBLb Bicycle: 0	SBRb Bicycle: 0

Analysed video file

frame no: 170      2019-09-27 10:00:07.760000

# High resolution sensors

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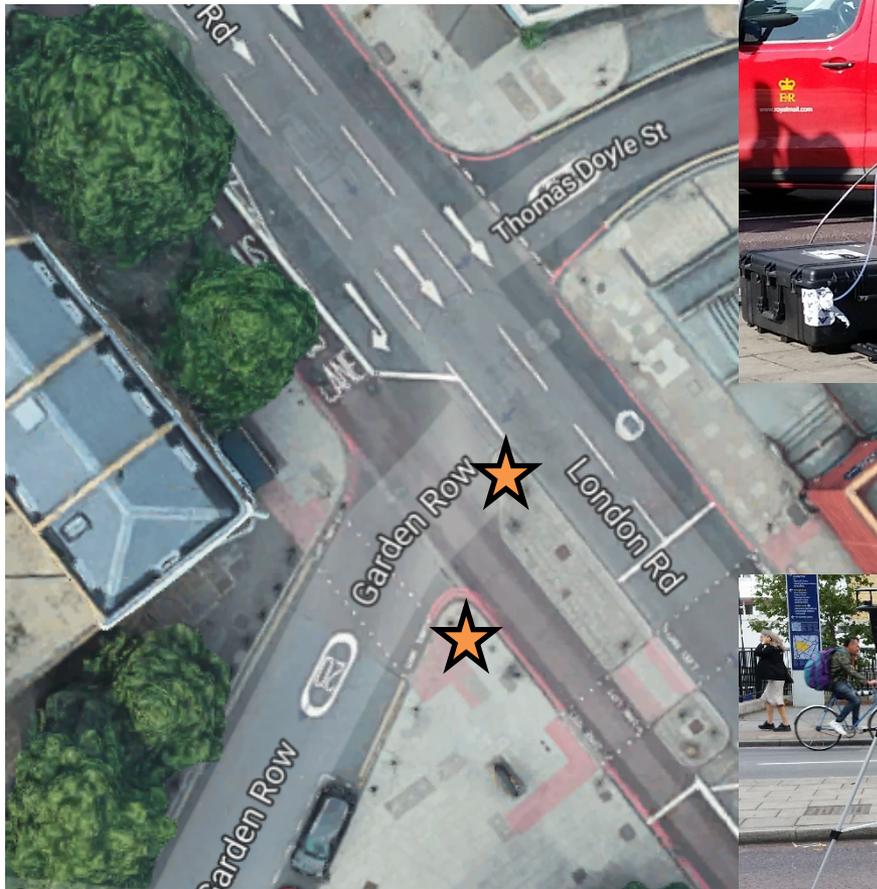
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### Sensors on central island:

- CAPS (NO<sub>2</sub>, 1s)
- 2BTech 405 (NO/NO<sub>x</sub>/NO<sub>2</sub>, 5s)
- Partector (LDSA, 1s)
- Aethalometer (black carbon, 1s)
- LICOR (CO<sub>2</sub>, 1s)
- Low cost sensor (CO/CO<sub>2</sub>/NO<sub>2</sub>, 30s)

### Sensors next to bus lane:

- Chemiluminescence (NO/NO<sub>x</sub>/NO<sub>2</sub>, 1min)
- Aethalometer (black carbon, 1s)
- Anemometer (wind speed and direction)
- Low cost sensor (CO/CO<sub>2</sub>/NO<sub>2</sub>, 30s)

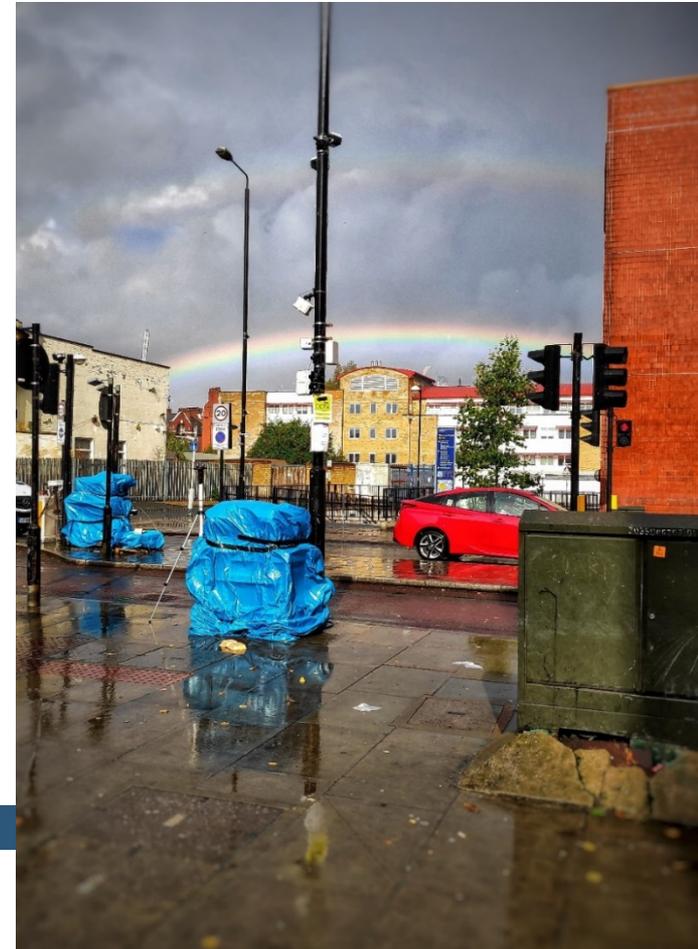


# Research questions

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- Signal time effects:
  - Emissions / Air Quality
  - Traffic conditions
  - Bus journey times
  - Pedestrian exposure
- High emitters
- Validate MAGIC models

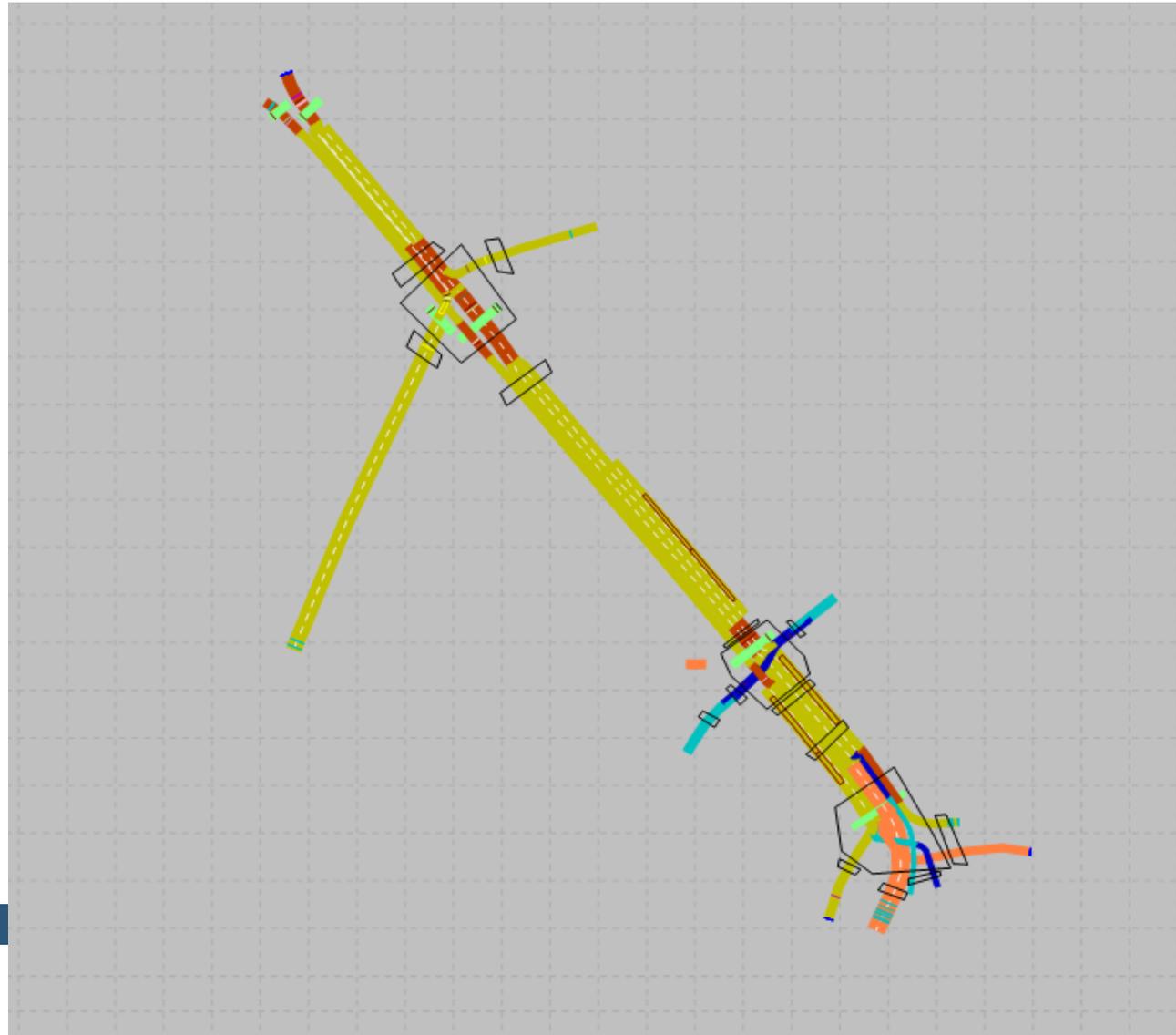


# Traffic modelling

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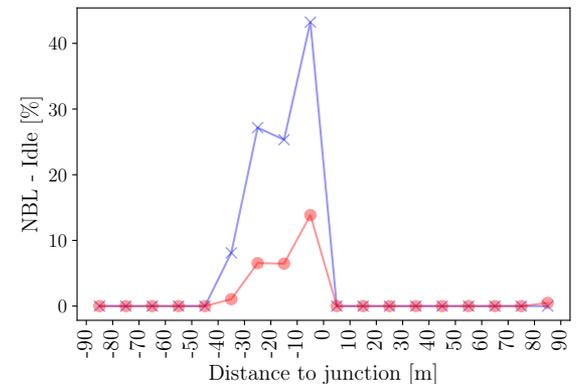
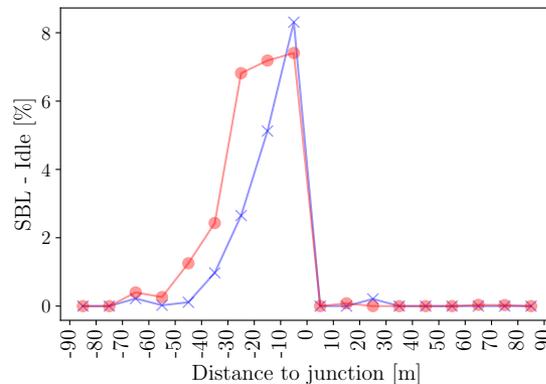
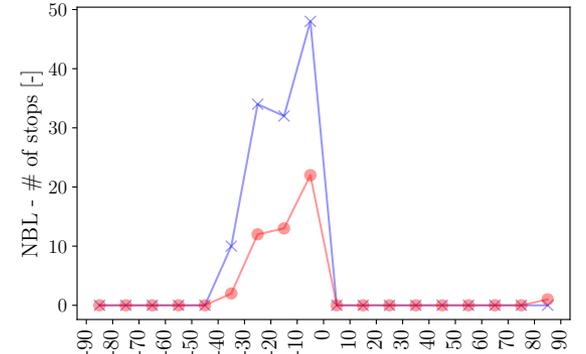
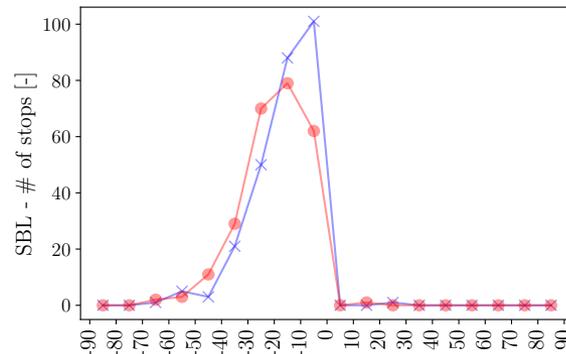
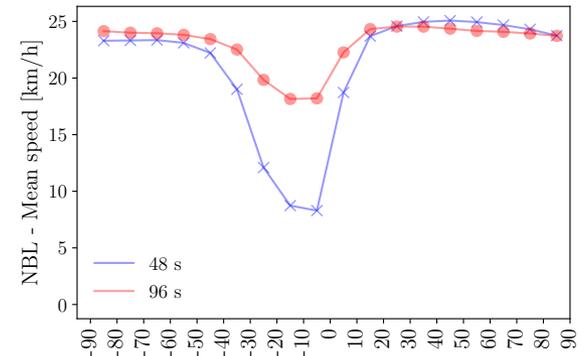
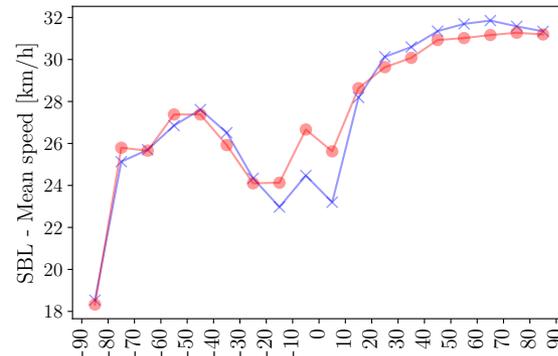
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- Traffic microsimulation model (TfL)
- Calibrated using manual traffic counts
- In the future, real counts from cameras will be added, vehicle trajectories will be compared



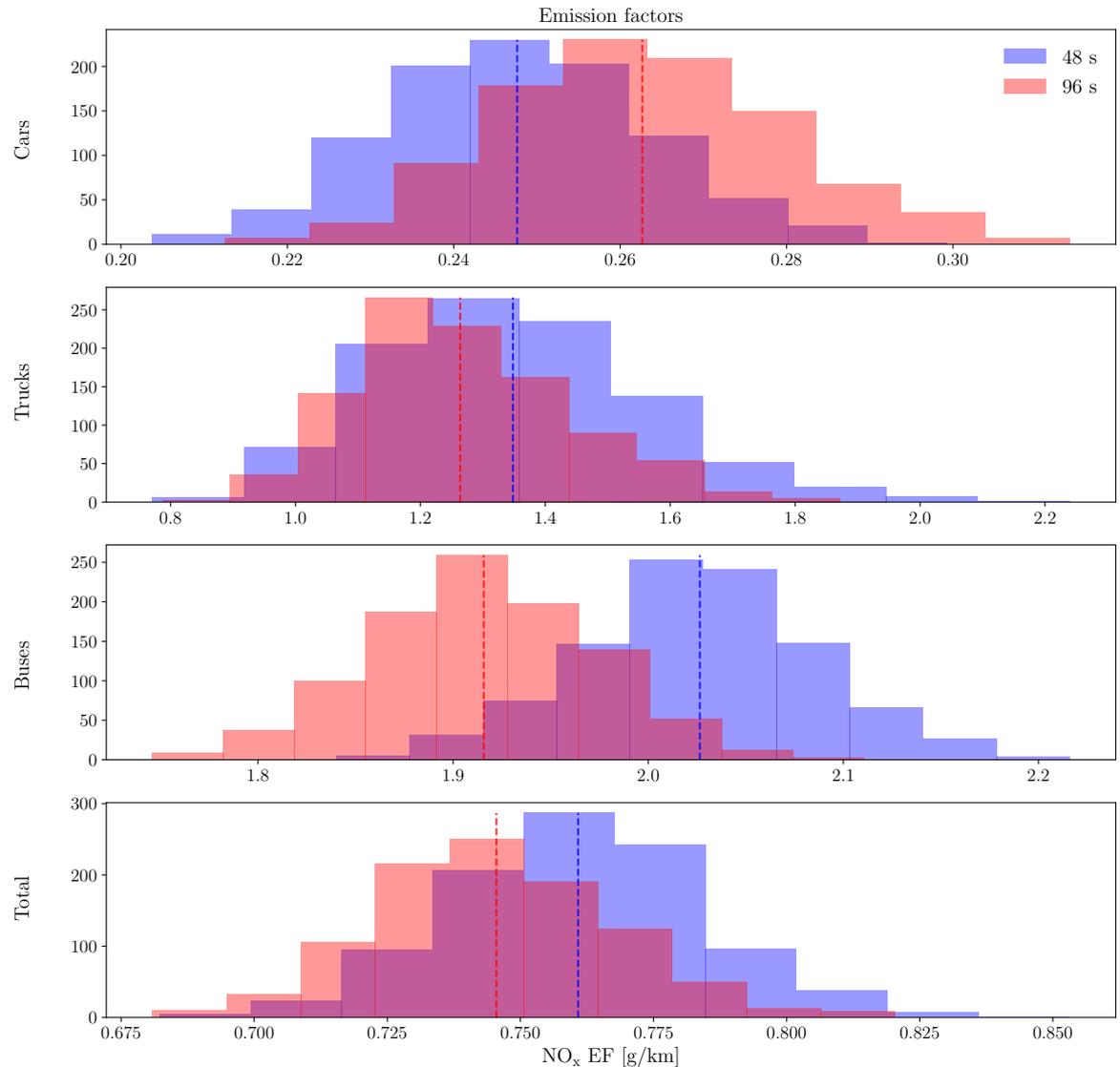
# Traffic comparison

- The traffic interventions directly impact the traffic conditions, particularly before the junction
- For the bus lane, the impact is extremely clear, with a smoother flow
- For the SBL, vehicles tend to queue further away from the junction



# Emissions calculation

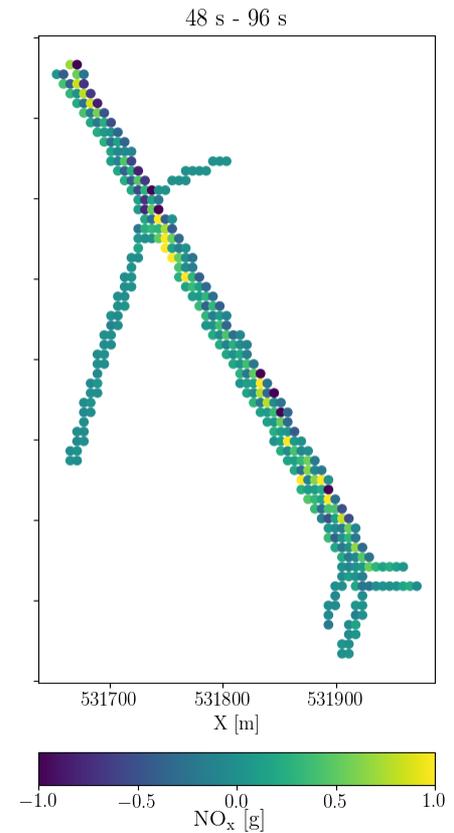
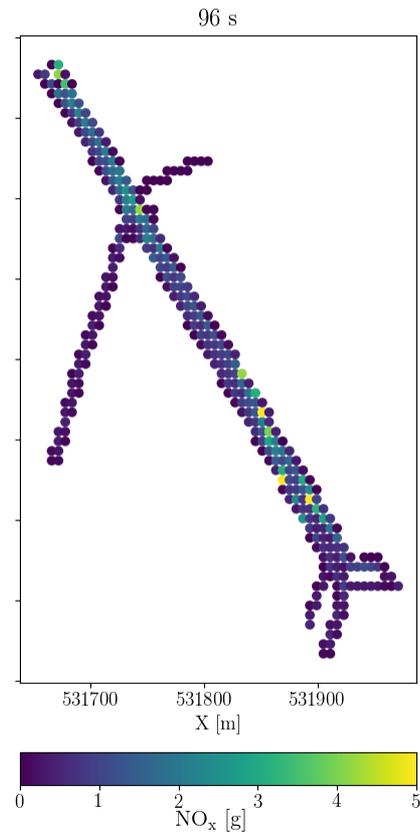
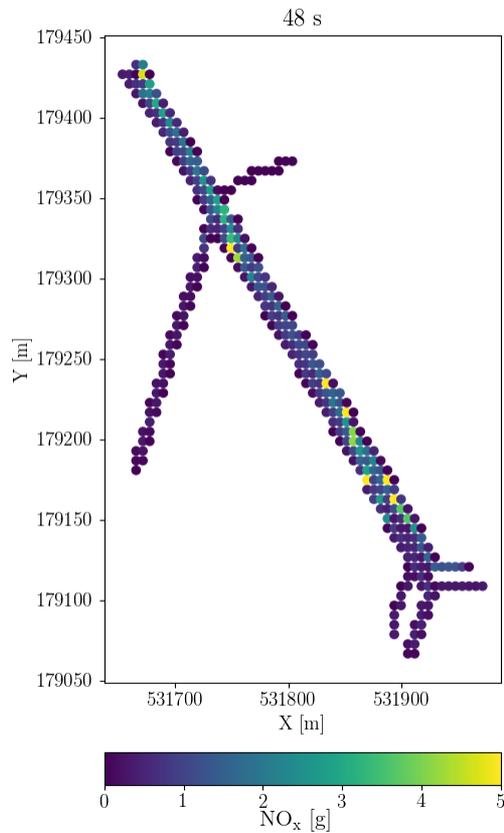
- Instantaneous emissions model
- ULEZ fleet
- Euro VI buses were assumed, but in reality, they are Euro VI hybrid
- Comparison over the entire network
- The largest difference is for buses, which was expected.



# Spatial distribution in emissions

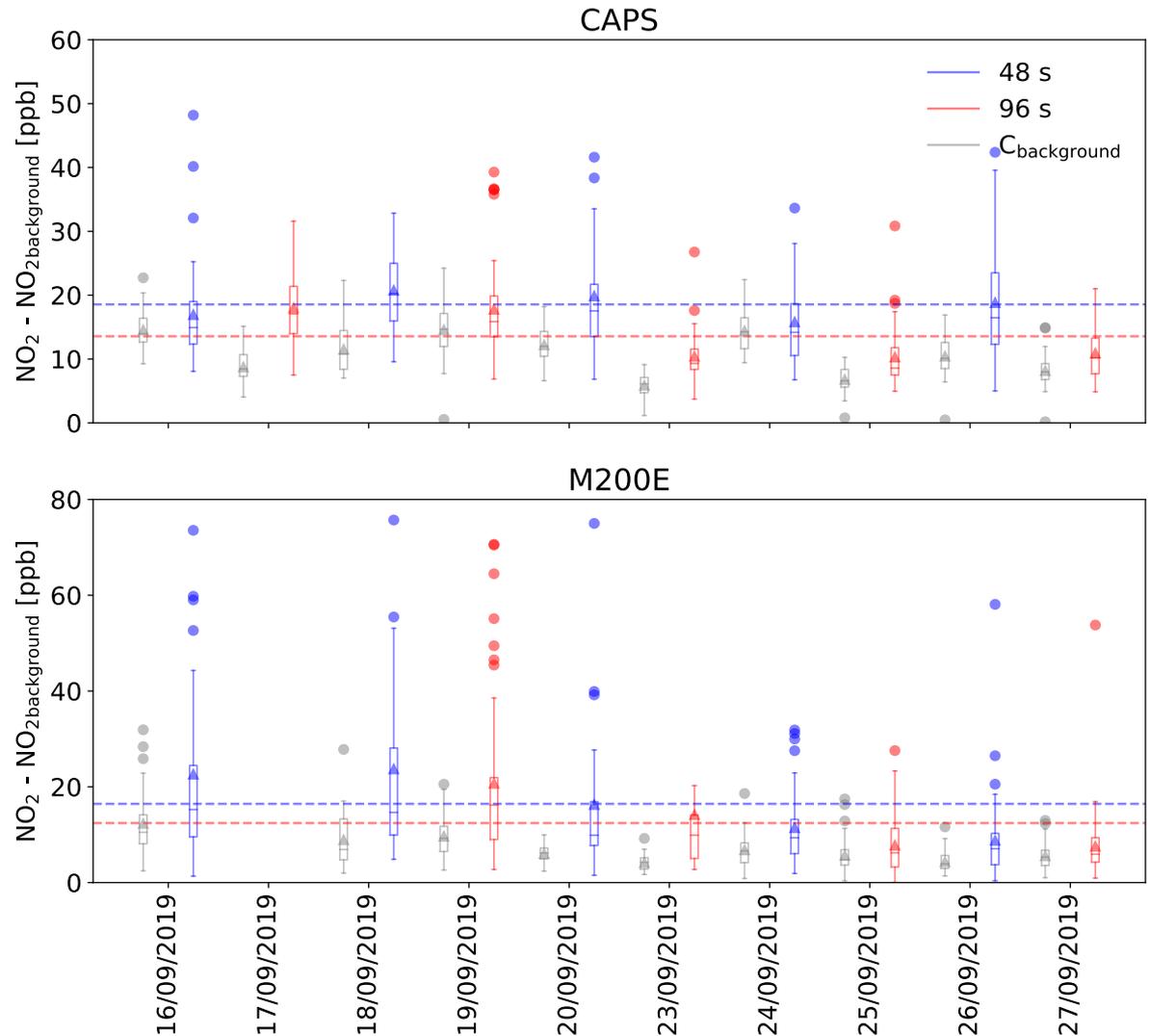
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# NO<sub>2</sub> concentrations

- On average, the 48 s cycle results in slightly higher average concentration
- Type of buses probably explain the lowest signal for the M200E



# Conclusions

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- The traffic intervention has a direct impact on emissions and the very local air quality (5 ppb lower on average for the CAPS and 3 ppb lower on average for the M200E)
- In the 96s cycle, part of the SBL emissions is moved upstream from the junction
- In the 96s cycle, pedestrians need to wait about twice longer for crossing the street
- Work is still on-going: analysis of the low cost sensors, modelling with Fluidity, analysis of the impact of high emitters, analysis of pedestrian exposure.

# Questions?

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