London Air Quality Pre and Post ULEZ

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By Ioana and Mina

Changes to levels of PM_{10} and Nitrogen Dioxide in Central London before and after the introduction of the Ultra-Low Emissions Zone (ULEZ)

What is NO_2 and PM_{10}?

- Nitrogen Dioxide (NO_2) is produced by burning of **fuel**, especially **diesel-run engines**
- Causes irritation in respiratory system
- Particles smaller than about 10 micrometers or PM_{10} (**dust**, **rubber** and **metal** from engine wear)
- Can settle in the airways and lungs, worsening heart and lung diseases

The Research

Our hypotheses are:

1. The introduction of ULEZ decreased the amount of NO_2 in Zone 1 of Central London by an effect size of at least 0.3.
2. The introduction of ULEZ was at least 1.25 as effective than the introduction of LEZ in reducing NO_2 levels in Central London.
3. The introduction of ULEZ decreased the amount of PM_{10} in Zone 1 of Central London by an effect size of at least 0.4.
4. The introduction of ULEZ was at least 1.5 as effective as the introduction of LEZ in reducing PM_{10} levels in Central London.

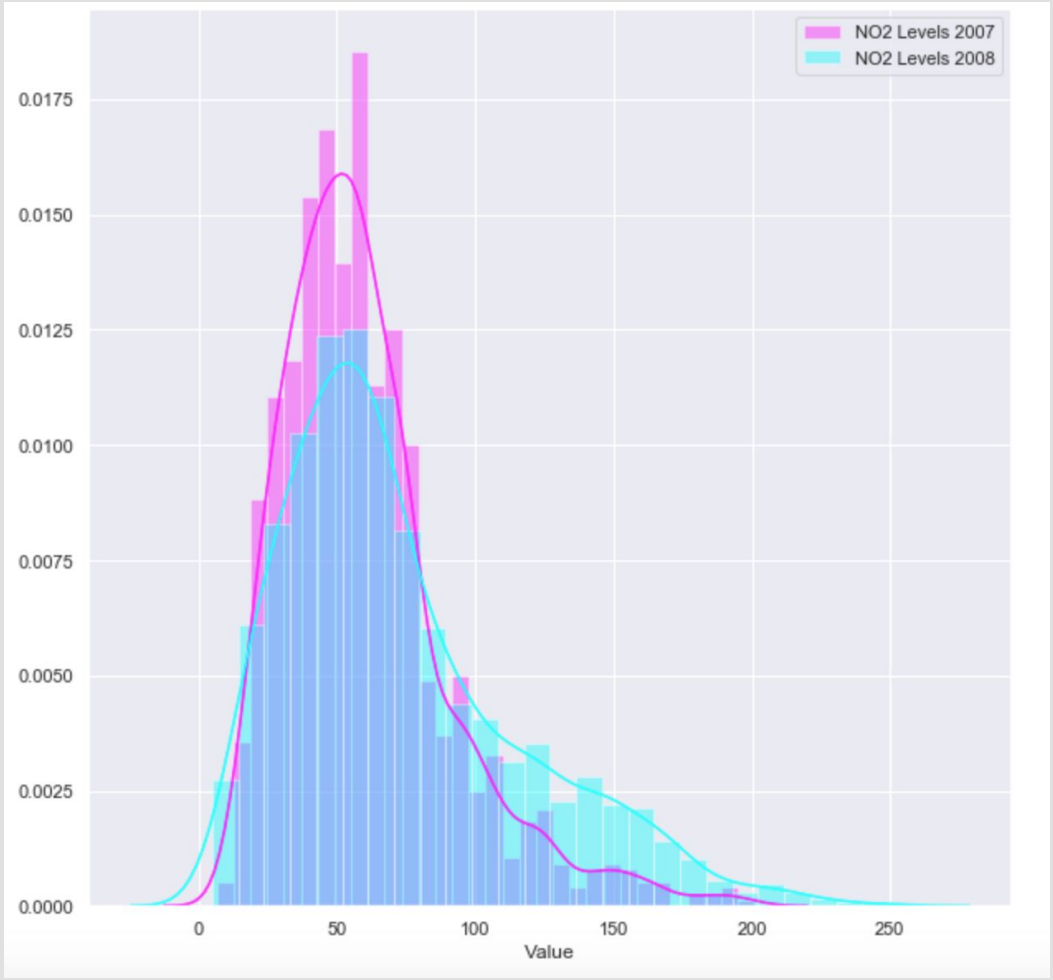
Methodology and data

Took King's College London Air quality data from the following sites for the following pollutants:

NO_2		PM_{10}	
CT3	City of London, Sir John Cass School	CT3	City of London, Sir John Cass School
KC1	Kensington and Chelsea, North Kensington	CT8	City of London, Upper Thames Street
HK6	Hackney, Old Street	MY7	Westminster Marylebone Road FDMS
CT6	City of London, Walbrook Wharf	HK6	Hackney, Old Street
WM6	Westminster, Oxford Street	WM6	Westminster, Oxford Street

Methodology and data

- Data by King's College London (London Air Quality Network, LAQN)
- Sampled data for two months of years 2007, 2008, 2018, 2019 to get normal distributions
- Welch T-test
- Final outcome: Cohen's d effect size
- Alpha threshold set to 0.05; power to 0.8

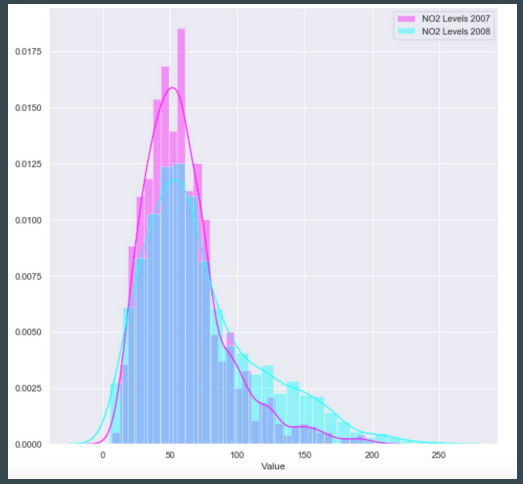


NO2 Values

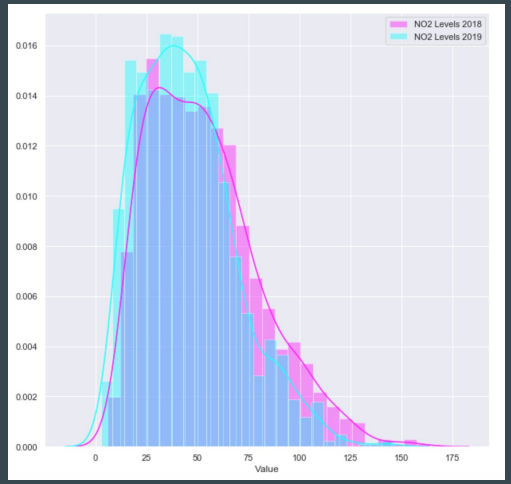
Pre LEZ (2007)

And Post LEZ (2008)

A



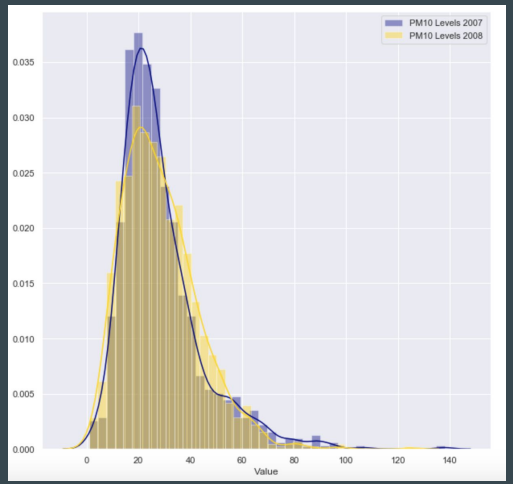
B



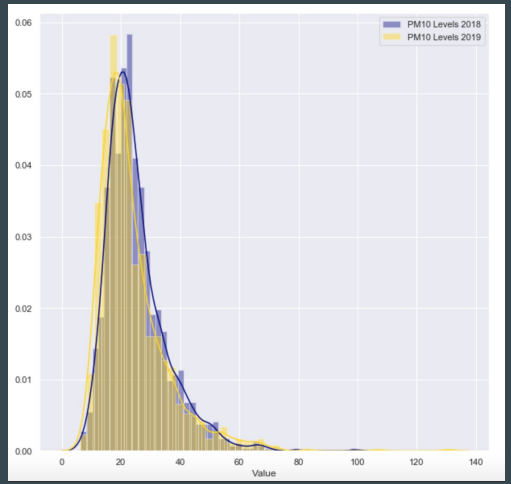
A. NO2 Levels
Pre- and Post LEZ

B. NO2 Levels
Pre- and Post ULEZ

C

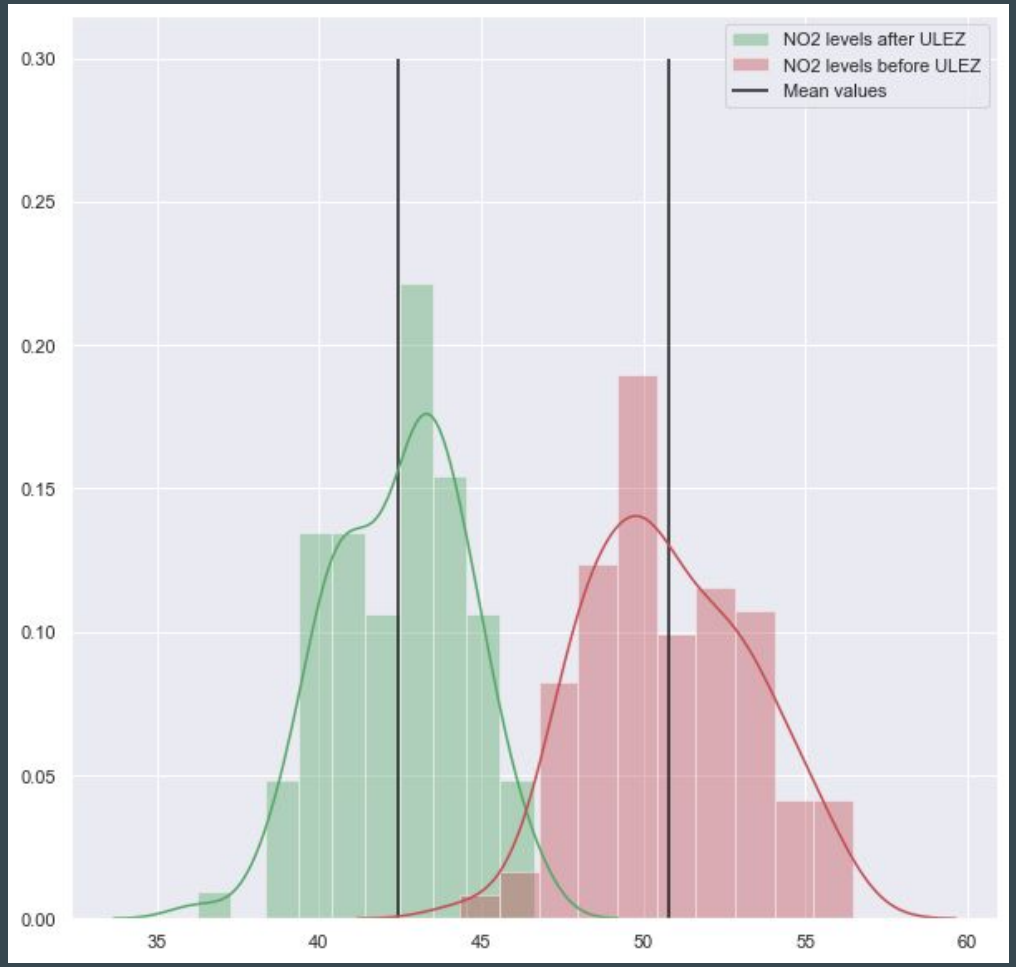


D

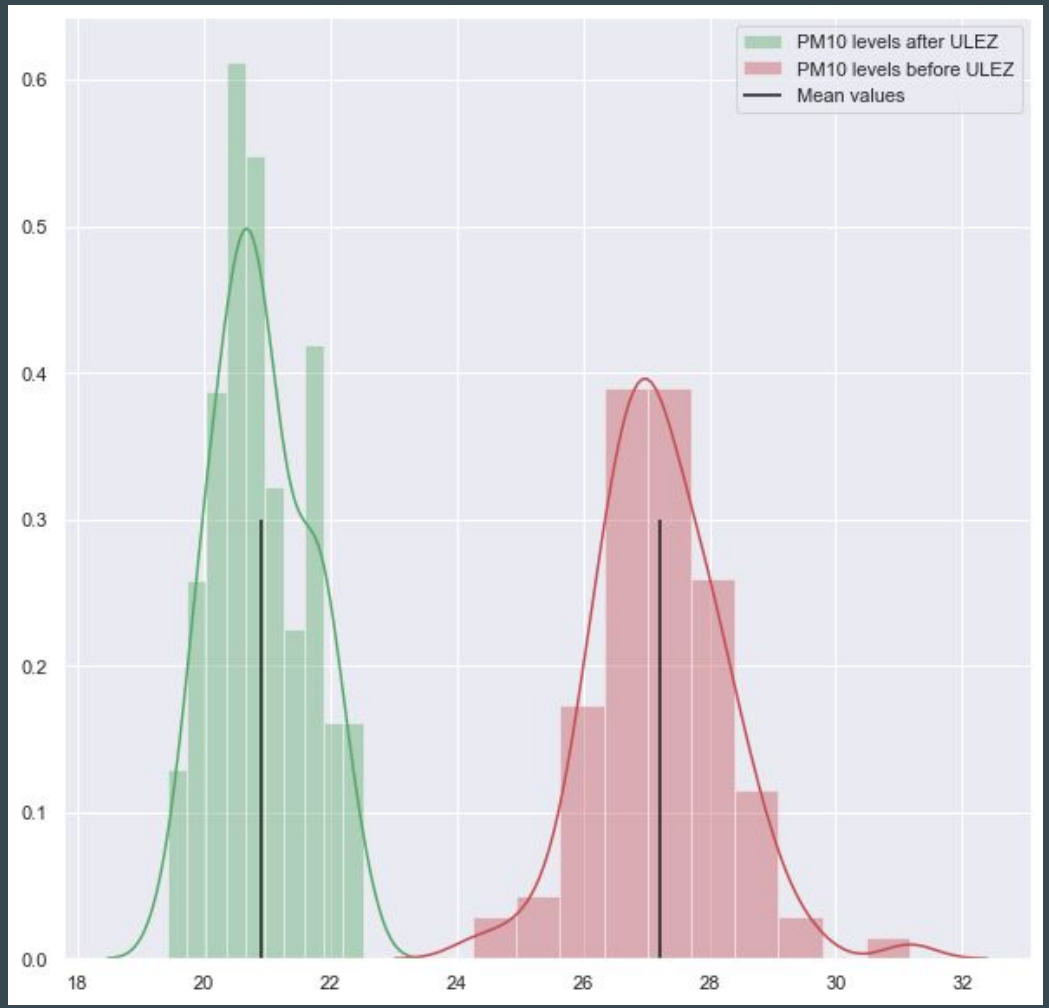


C. PM10 Level
Pre- and Post LEZ

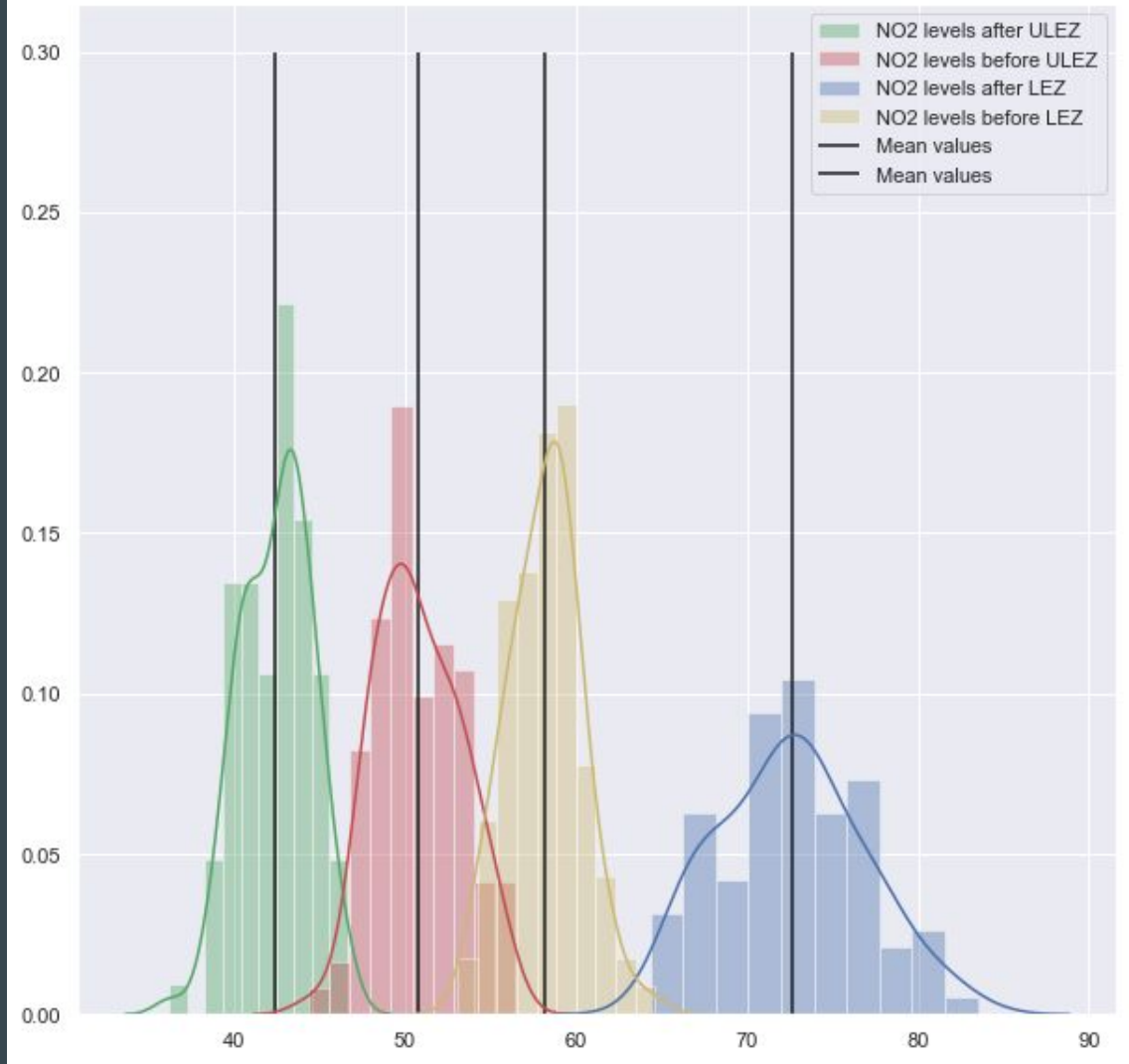
D. PM10 Levels
Pre- and Post ULEZ



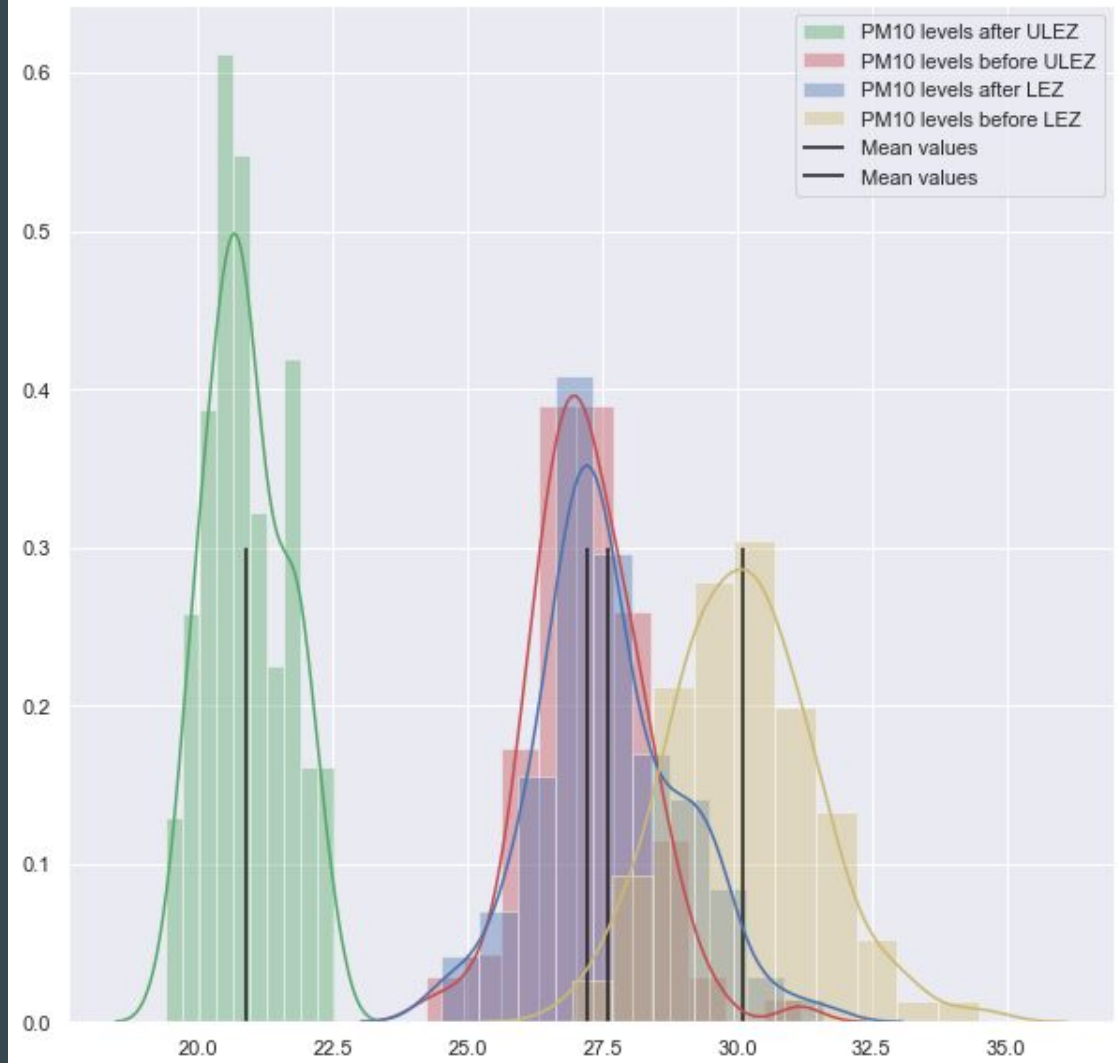
NO_2 Samples pre- and post-ULEZ Cohen's d = -3.657



PM_{10} samples pre- and post-ULEZ
Cohen's d = -7.025



NO_2 samples before and after ULEZ and LEZ Ratio of Cohen's d's : 0.848



PM_{10} samples before and after ULEZ and LEZ
Ratio of Cohen's d's : 3.66

Going forward:

Limitation of our results:

- Smaller population of data for post-ULEZ

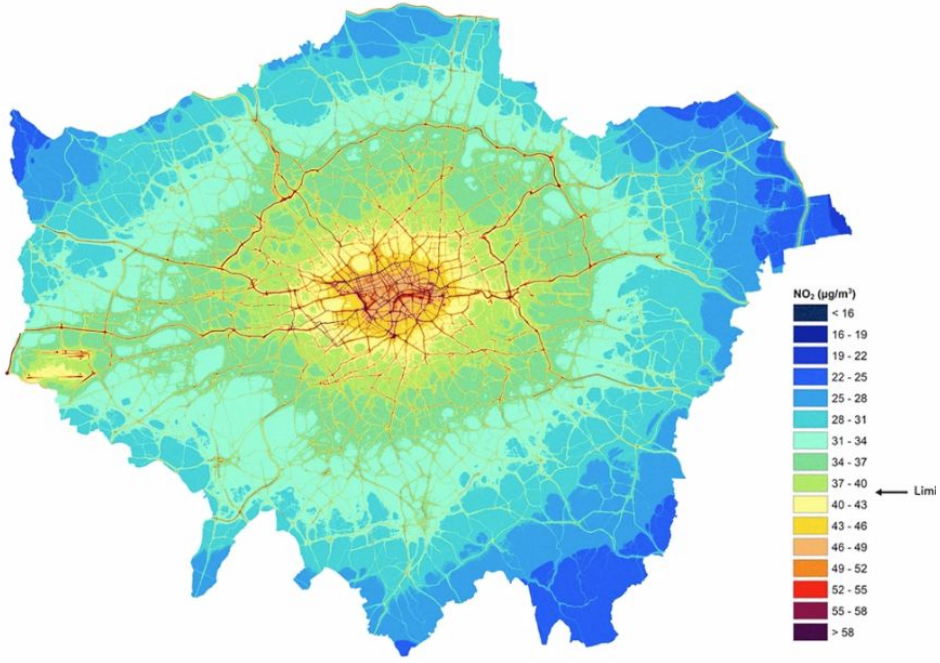
- Unevenly distributed data for the Central London sensors

Next steps:

- Repeating sampling and analysis for other pollutants ($PM_{2.5}$ and CO)

- Choosing Inner & Outer London sites for testing impact of LEZ

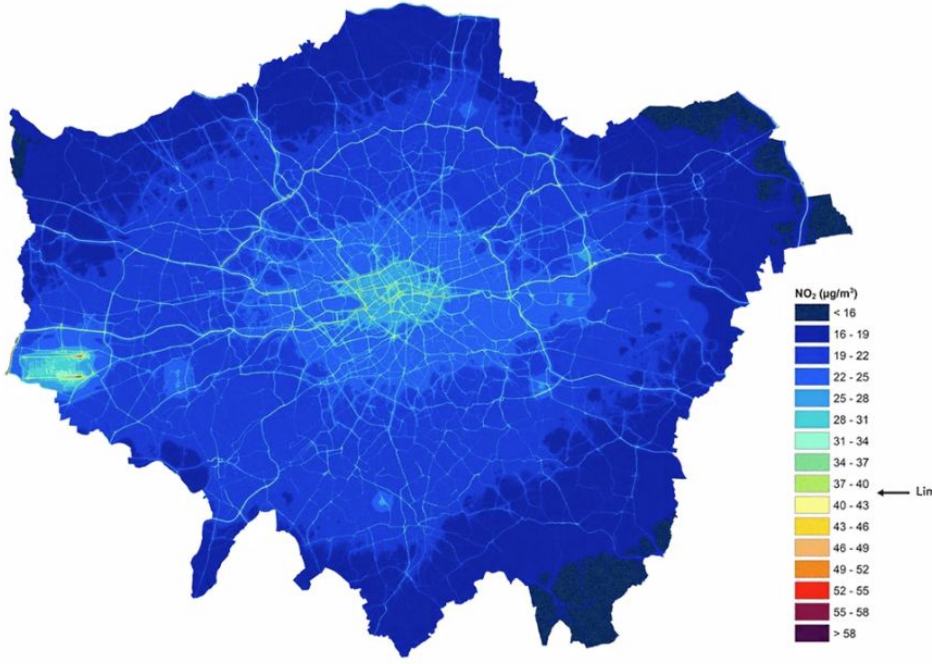
London's air pollution before ULEZ



Reference: LAEI, 2016

GIF

And in 2025, after ULEZ and the Mayor's other actions



Reference: London Environment Strategy, 2018

GIF

Conclusion

Our research shows that ULEZ was effective in reducing NO_2 and PM_{10} levels by a significant margin.

Interestingly, ULEZ was significantly more effective in reducing PM_{10} than LEZ was, whereas LEZ had a moderately larger impact on NO_2 than ULEZ.

Appendix

NO2 Level (ULEZ)

Based on the p value of 0.0 and our alpha of 0.05 we reject the null hypothesis.

Due to these results, we can state that there is a difference between our samples with an effect size, Cohen's d, of -3.469 and power of 1.0.

PM10 Level (ULEZ)

Based on the p value of 0.0 and our alpha of 0.05 we reject the null hypothesis.

Due to these results, we can state that there is a difference between our samples with an effect size, Cohen's d, of -6.773 and power of 1.0.

NO2 LEZ vs ULEZ

Based on the p value of 0.0 and our alpha of 0.05 we reject the null hypothesis. Due to these results, we can state that there is a difference between our samples with an effect size, Cohen's d, of -3.657 and power of 1.0.

The effect of ULEZ on the levels of NO2 was 0.848 times than the effect of LEZ.'

PM10 LEZ vs ULEZ

Based on the p value of 0.0 and our alpha of 0.05 we reject the null hypothesis.
Due to these results, we can state that there is a difference between our samples with an effect size, Cohen's d, of -7.025 and power of 1.0.

The effect of ULEZ on the levels of PM10 was 3.66 times greater than the effect of LEZ.