



IMPROVING THE PUBLIC REALM WITH DATA

Impact assessment of the summer closures on
Blackett Street

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Objectives and problem statement

Determine if there are detectable changes on air quality during the summer road closures on Blakett Street.

Data

We have considered pollution data from the Urban Observatory which is publicly available at <http://www.urbanobservatory.ac.uk>. We have focused on NO₂ data.

Data for economic impact was not sufficient to support conclusions and therefore has not been included in this report.

A list of additional data supplied that revealed to be insufficient to make robust conclusions is listed in appendix at the end of this report.

Results

The results of this analysis are inconclusive regarding permanent closure of the street. The reasons for this are the following:

- Not enough data, only 10 weekends of data where the street was closed.
- Street was closed to host special events (Great exhibition of the North), not representative of other days.
- Street was closed during weekends, this cannot be generalised to week days as traffic patterns will be completely distinct.
- Closure during summer is not representative of winter (people might use the car more often in the winter, less students during summer holiday period, etc)
- Analysis with NO₂ measurements is not enough to fully understand air pollution. The relationship between air quality and traffic is complex and is affected by weather conditions, e.g. wind direction and the surface topography (building form, street type, presence of vegetation – trees etc.) The data needs to be normalised for weather to allow meaningful comparison between days. The indicative electro-chemical air quality sensors are also sensitive to temperature and humidity and can drift over time.

For the reasons above the results discussed for the rest of this report only refer to the summer closures and cannot be generalised to other periods of time.

Step 1: Preliminary analysis - comparison of NO₂ values between closure in 2018 with same period last year. Results suggest:

- Geographically it suggests that pollution decreased in some locations in the city centre and increased in adjacent streets – Figure 1.
- Detailed analysis of locations where NO₂ changed the most, shows that in places where it decreased the most, on average, also showed a decrease in the maximum values of NO₂ – Figure 2.
- Mean values across multiple sensors show that pollution in most weekends was less than last year – Figure 3.

First step of analysis only compares 10 weekends in 2018 with 10 weekends in 2017. For step 2, we overcome this by performing a time series decomposition which allows us to compare the closure weekends with more days, regardless of time of year or week period.

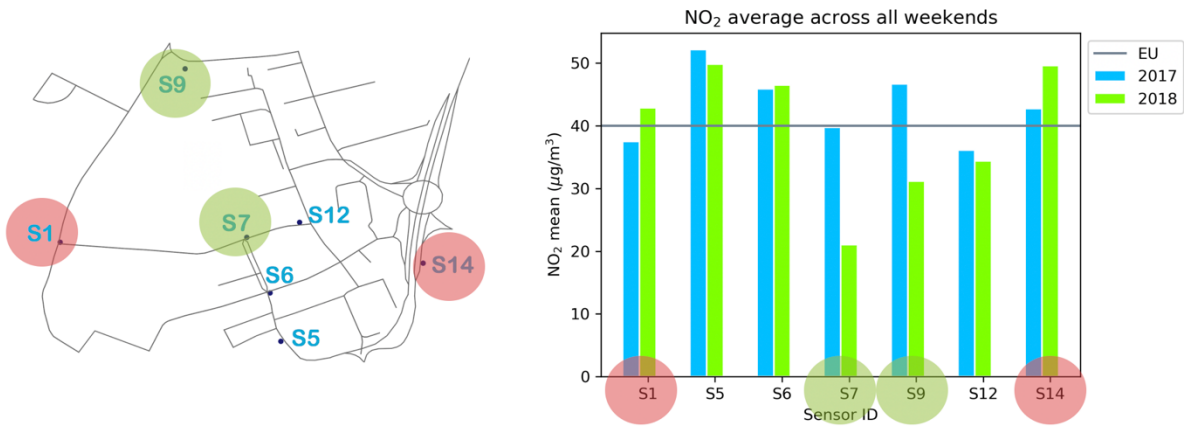


Figure 1 - Comparison between the road closure weekends in 2018 and equivalent period in 2017 suggests decrease in pollution at sensors with ID S7 and S9, and an increase at locations with sensor ID S1 and S14.

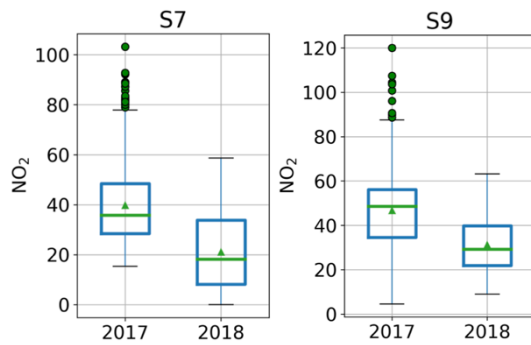


Figure 2 - Comparison between the road closure weekends in 2018 and equivalent period in 2017 suggests locations where NO₂ decreased the most, on average, also showed a decrease in the maximum values of NO₂.

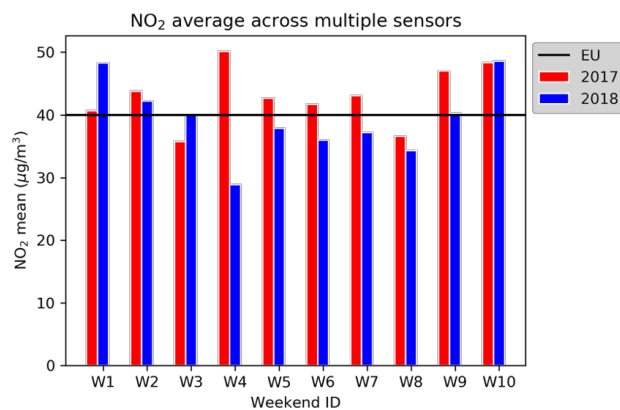


Figure 3 - Comparison between the road closure weekends in 2018 and equivalent period in 2017 suggests decrease in pollution for most weekends. Results were averaged across all seven sensors presented in Figure 1.

We cannot overcome the fact that we only have 10 weekends worth of data where the street was closed to traffic. However, we would like to have more days to compare with than just the equivalent period in 2017. To do this we have to remove seasonal and daily effects to allow for a meaningful comparison. This can be achieved with a time series decomposition.

Step 2: Time series decomposition

- Split time series (NO_2 as a function of time) in three components: Observed = Trend + Seasonal + Residual.
- Trend – captures trend of the measurements (ex. higher pollution in Winter vs Summer, week days vs weekends).
- Periodic – captures repeating patterns, in our case describes daily behaviour (at 3am is different from 5pm).
- Residual – What could not be captured by the other two components. In principle a typical day will have small residuals, special days like bank holidays or closure weekends should have higher residuals.

Once we remove the trend and the periodic components, we can compare residuals of closure weekends with residuals of other days to observe if there are detectable changes.

For this analysis data from sensors shown in Figure 4 and the period from the end of December 2017 to mid-September 2018 was considered.

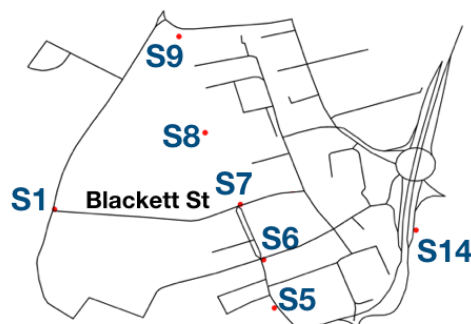


Figure 4 - Sensors used in time series analysis.

In order to draw conclusions, we must first establish if our results are statistically significant. We do that using a t-test, which is a statistical tool that tell us if two samples are different and with which probability our results are due to chance.

T-test results:

- Residuals across sensors considered are less during the closure period than on average and that the results are statistically significant – Table 1.
- This suggests an improvement on air quality in the city centre **during the summer road closure** in Blackett Street.

Table 1 – t-test results from comparing residuals during closure weekends with residuals from other days. Period considered for the time series decomposition: end of December 2017 to mid-September 2018.

Sensor ID	Street name	T value	P value
S9	Northumberland St	-2.79190389	0.00527182
S8	Northumberland St	-2.70955587	0.00677419
S5	Pilgrim St	-2.0833676	0.037299
S6	Market St	-2.42002319	0.01557633
S1	Percy St	-3.45949455	0.00054845
S14	Trafalgar St	-2.95440762	0.00315614
S7	Blackett St	-3.4499367	0.00056816

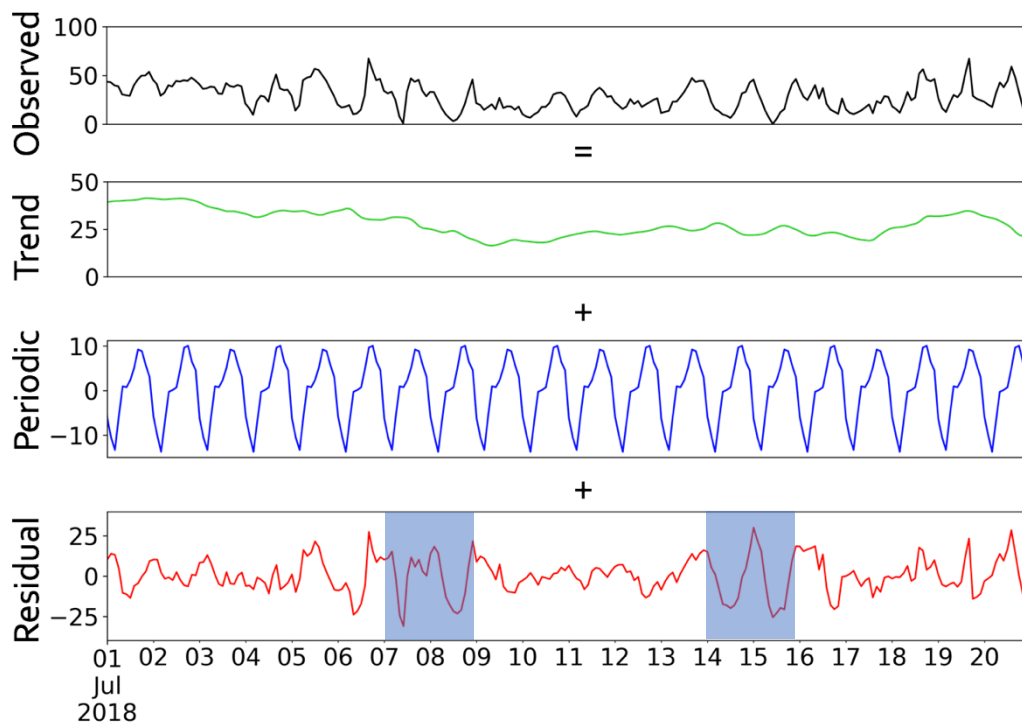


Figure 5 - Time series decomposition for part of July. Data from sensor ID S7 (see Figure 2). Residuals highlighted for two of the closure weekends. For this analysis data from the end of December 2017 to mid-September 2018 was considered.

Recommendations

In order to draw robust conclusions more data is required. Vehicle counts in adjacent streets to Blackett Street should be measured to validate pollution analysis and understand movements of people (relevant for economic impact).

My recommendation is to measure for extended periods of time variables below to allow meaningful comparisons with closure periods

- Count vehicles
- Measure journey times
- Count number of people
- Financial records of local businesses

In addition, different and longer closure periods should be considered in order to be able to make conclusions about the impact of a permanent closure.

Summary

There are detectable changes in NO₂ measurements during closure weekends which suggest a decrease of NO₂ in the city centre during this period. However, this is not sufficient to have a comprehensive understanding of pollution and air quality during the closure weekends. These results are not robust to support conclusions regarding the permanent closure of Blakett Street.

Appendix

Data supplied that was not sufficient to support conclusions:

- Diffusion tube data at different locations 2017-2018
- Car park occupancy for some of the closure weekends in 2018 and equivalent period last year
- Vehicle counts outside the bus loop
- Vehicle counts at the bus loop for a period that did not include closure weekends
- Number of people on Blakett Street during closure weekends
- Bus boarding data for closure weekends in 2018 and equivalent period last year