Air Quality Evaluation on I-210 Freeway Before-And-After Safer-At-Home Order During COVID-19 Pandemic

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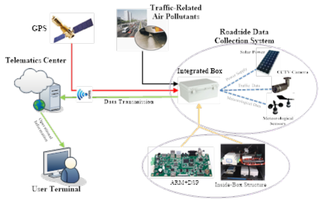
Collection Area & Methods



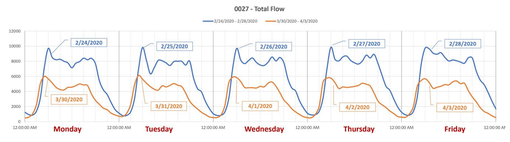
Traffic

Traffic data was obtained from the Caltrans Performance Measurement System (PeMS). The raw data is collected from single lane detectors, which measure flow and occupancy every 30 seconds. From the data, we extracted hourly total flow, hourly truck volume, and speed data in time series. The location of the data collected is on the I-210 Freeway in the City of Pasadena in Los Angeles County.

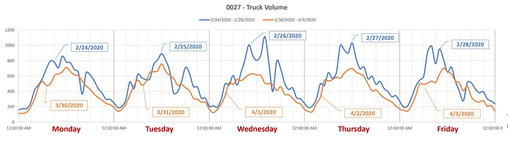
Air Quality

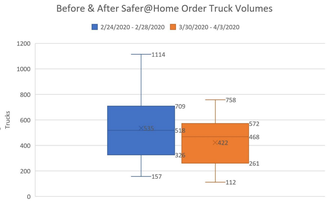
Air pollutant data was collected by a previously installed air pollution monitoring unit. The unit has an air quality measuring system, approved by the EPA, to measure concentrations of CO_2, CO, NO_2, NO, O_3, and PM2.5. The unit also contains a meteorological monitoring system to collect temperature data. Data is collected every two minutes and sent via a central control system. To be consistent with the traffic data, the raw 2-minute pollutant data was transformed into 1-hour base by averaging.

Traffic Data Statistics

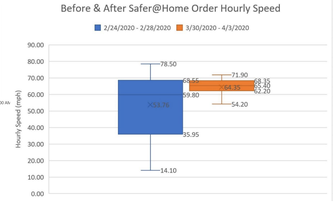


Total Flow from Before to After Safer@Home Order:
- Mean → 23% Reduction
- 25th Percentile → 23% Reduction
- 75th Percentile → 20% Reduction



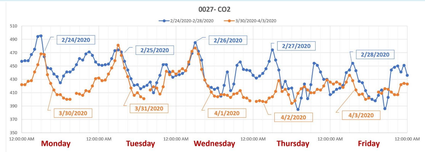


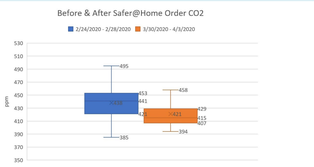
Truck Volume from Before to After Safer@Home Order:
- Mean → 21% Reduction
- 25th Percentile → 20% Reduction
- 75th Percentile → 19% Reduction



Hourly Speed from Before to After Safer@Home Order:
- Mean → 17% Increase
- 25th Percentile → 74% Increase
- 75th Percentile → 0.1% Increase

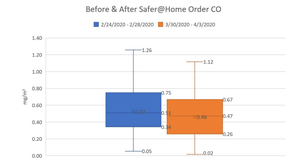
Air Quality Data Statistics





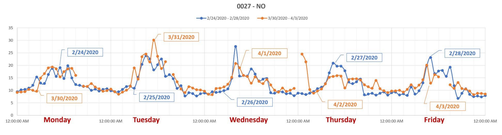
CO_2 from Before to After Safer@Home Order:
- Mean → 4% Reduction
- 25th Percentile → 3% Reduction
- 75th Percentile → 5% Reduction

A decrease in traffic congestion may have caused the reduction in CO_2. Acceleration and deceleration in congestion cause CO_2 to increase, therefore a reduction in congestion may cause a reduction in CO_2.



CO from Before to After Safer@Home Order:
- Mean → 12% Reduction
- 25th Percentile → 11% Reduction
- 75th Percentile → 24% Reduction

No clear correlation in CO observed in time plot. May be due to an increase in temperatures and an increase in hourly speed of vehicles. Even though an overall decrease was observed, it is not clearly correlated to one factor.



NO from Before to After Safer@Home Order:
- Mean → 5% Increase
- 25th Percentile → 11% Increase
- 75th Percentile → 1% Increase

No clear correlation in NO observed in time plot. May be due to an increase in hourly speed of vehicles. Even though an overall increase was observed, it is not clearly correlated to the increase in hourly speed as shown in the time plots.

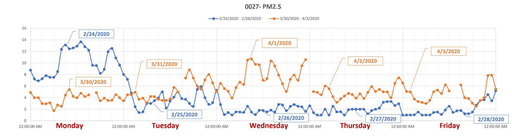
NO_2 from Before to After Safer@Home Order:
- Mean → 8% Increase
- 25th Percentile → 21% Increase
- 75th Percentile → 4% Increase

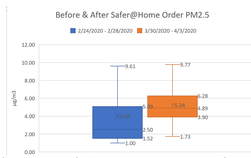
NO_2 increased during rush hour times shown in the time plot. The increase during rush hour is also observed in hourly speed. An increase in hourly speed may have caused the increase in NO_2.

Air Quality Data Statistics Cont.

O_3 from Before to After Safer@Home Order:
- Mean → 16% Increase
- 25th Percentile → 18% Increase
- 75th Percentile → 17% Increase

O_3 increased overall, though O_3 is a pollutant that is not directly emitted by vehicles. O_3 is created in a reaction with NO_x and sunlight. Even though these two pollutants are not directly correlated, an increase in NO_2, from an increase in hourly speed, may have led to an increase in O_3.

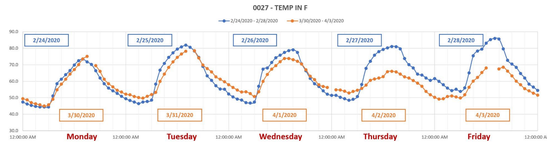


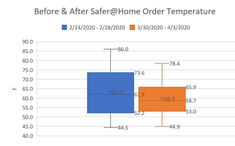


PM2.5 from Before to After Safer@Home Order:
- Mean → 24% Increase
- 25th Percentile → 19% Increase
- 75th Percentile → 62% Increase

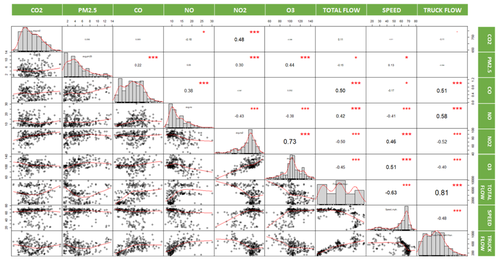
No clear correlation in PM2.5 with any traffic parameters. PM2.5 is derived by other pollutants, such as NO_x, though a clear correlation between the two pollutants is not seen. May assume a relationship between NO_2 and PM2.5 may cause the increase.

Meteorological Data





Matrix Analysis



A correlation matrix was used to find correlations between traffic parameters and air pollutants. The larger the number is, the more the variables are correlated. Positive and negative numbers dictate positive and negative correlation, respectively. CO_2 and PM2.5 do not show significant correlations. CO is shown to have significant positive correlation to total flow and truck flow. NO is shown to have significant positive correlation to total flow and truck flow. NO is also shown to have significant negative correlation to speed. NO_2 also shows to be significantly negatively correlated to total flow and truck flow and positively correlated to speed. O_3 has a similar correlation to traffic parameters as NO_2 and a significant correlation to NO_2.