

The Improvement of the Air Quality due to Traffic Halting in Los Angeles during the COVID-19 Outbreak

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Oct, 2020**

1. Improvement of the Air Quality in the LA Basin during the COVID-19 Outbreak based on Real-Time Data and CMAQ



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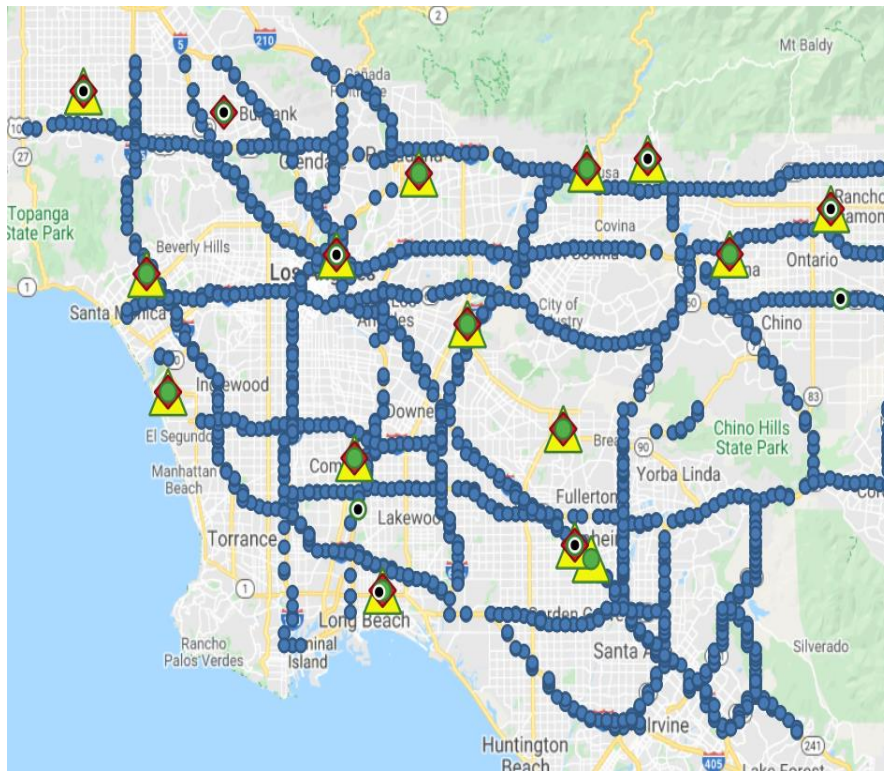


Dr. Barron Henderson
EPA



Prof. Joe Pinto
UNC

The Distribution of Sensors in LA Basin



Yang et al, 2020



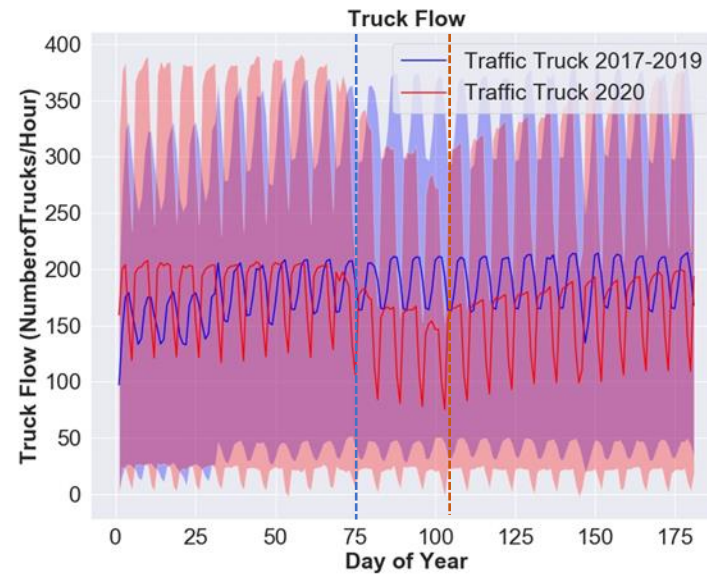
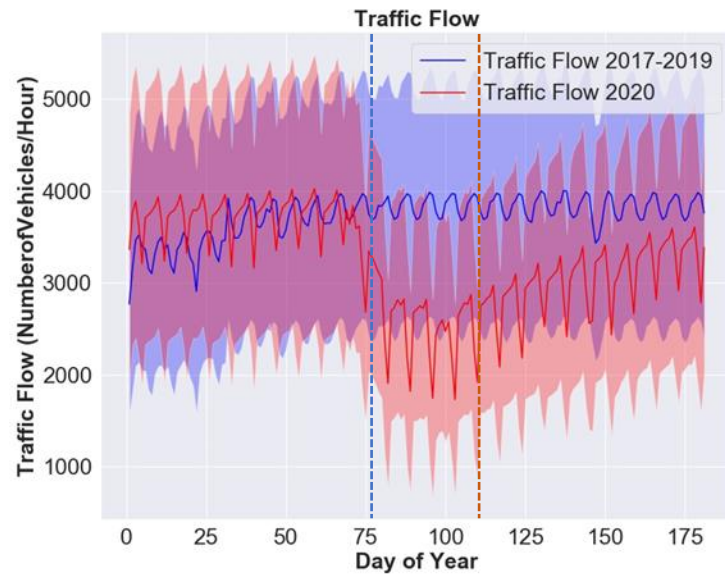
Lu et al, 2003

Weigh in Motion Systems measure the peraxle weight and gross weight of vehicles as they travel at highway speed. This technology detects axle-spacing so that vehicles can be identified by class.

	21		32	
	351		PERMIT	
	3512		2523	UNCLASSIFIED AND/OR SYSTEM ERRORS
			3513	
			3522	
			ALL OTHER 7+ AXLE	

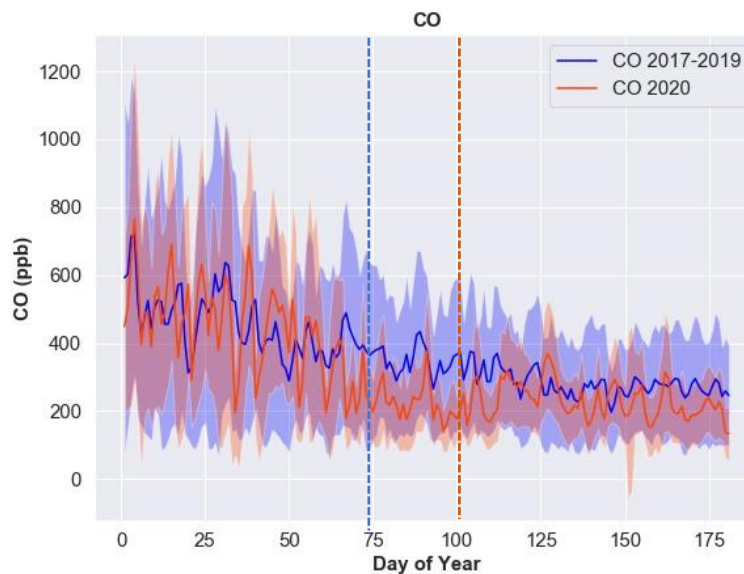
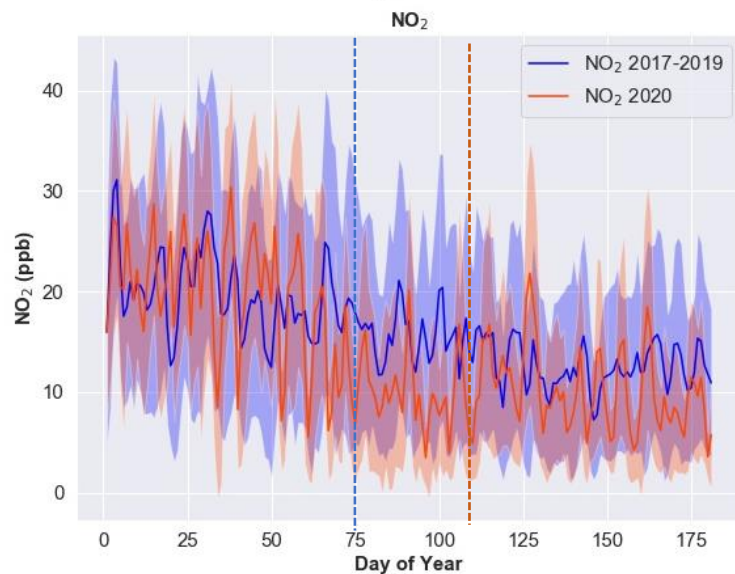
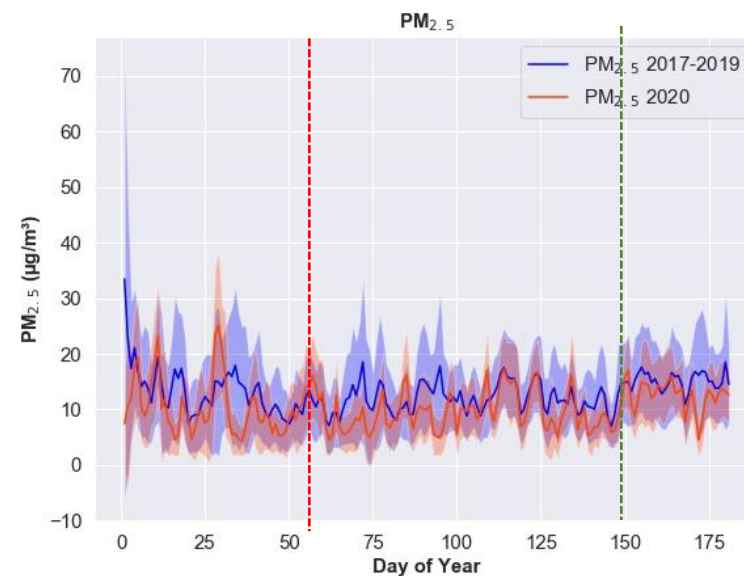
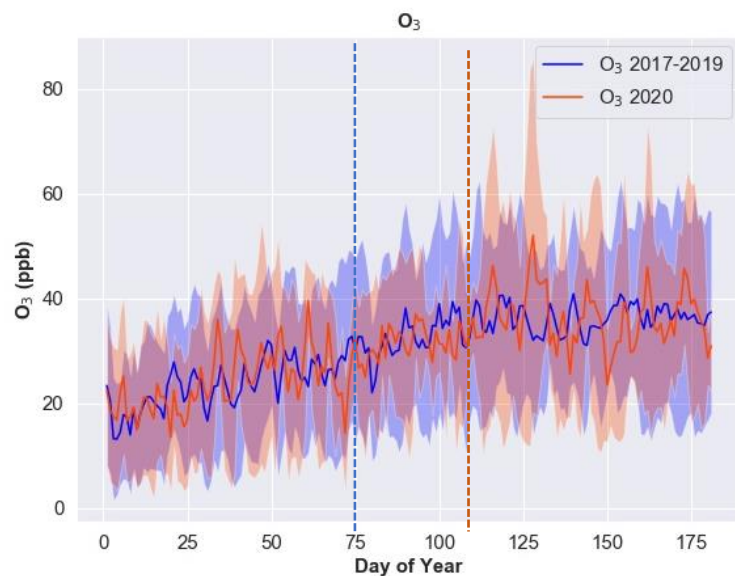
Figure 3. Typical vehicle profiles for Caltrans truck type.

Daily Traffic Pattern between 2017-2019 to 2020



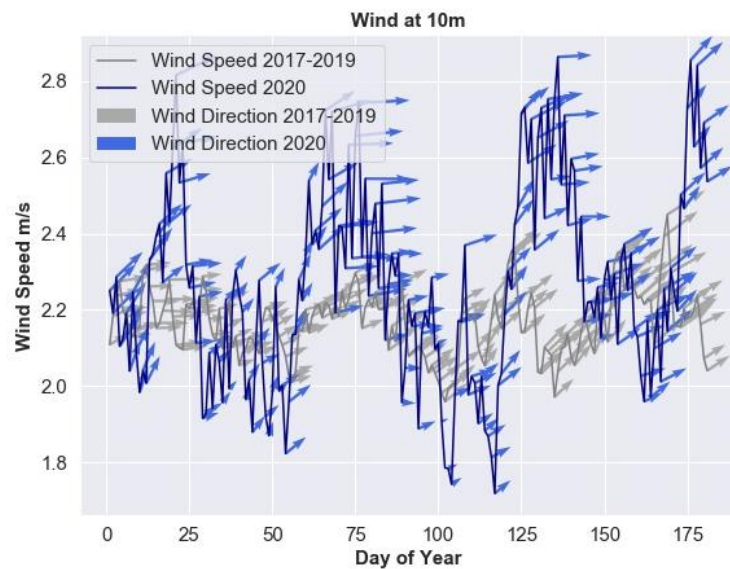
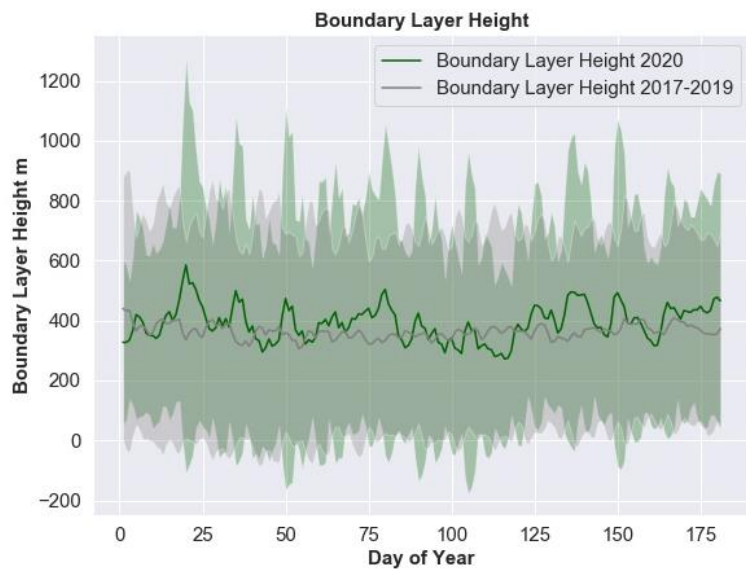
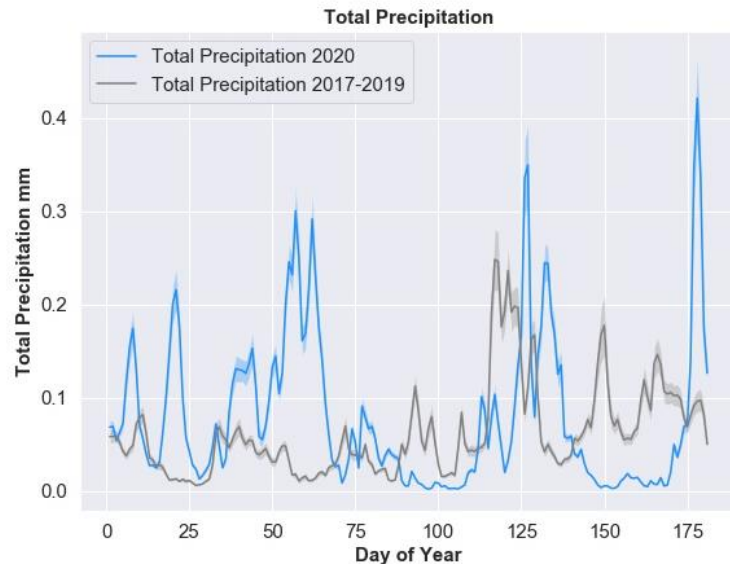
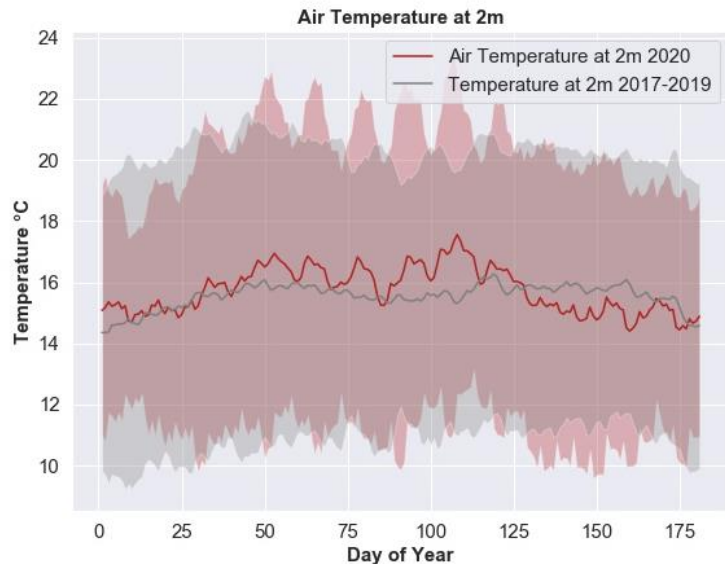
1. Starting from March 14, 2020 (Day of Year: 74) the traffic flow has dropped significantly from the year of 2017-2019 on a weekly basis;
2. Similar trend has been also observed in truck flow;
3. Traffic speed is opposite;
4. Traffic pattern returned back on April 14, 2020 (Day of Year: 105).

Daily Air Pollutants Pattern in LA Basin



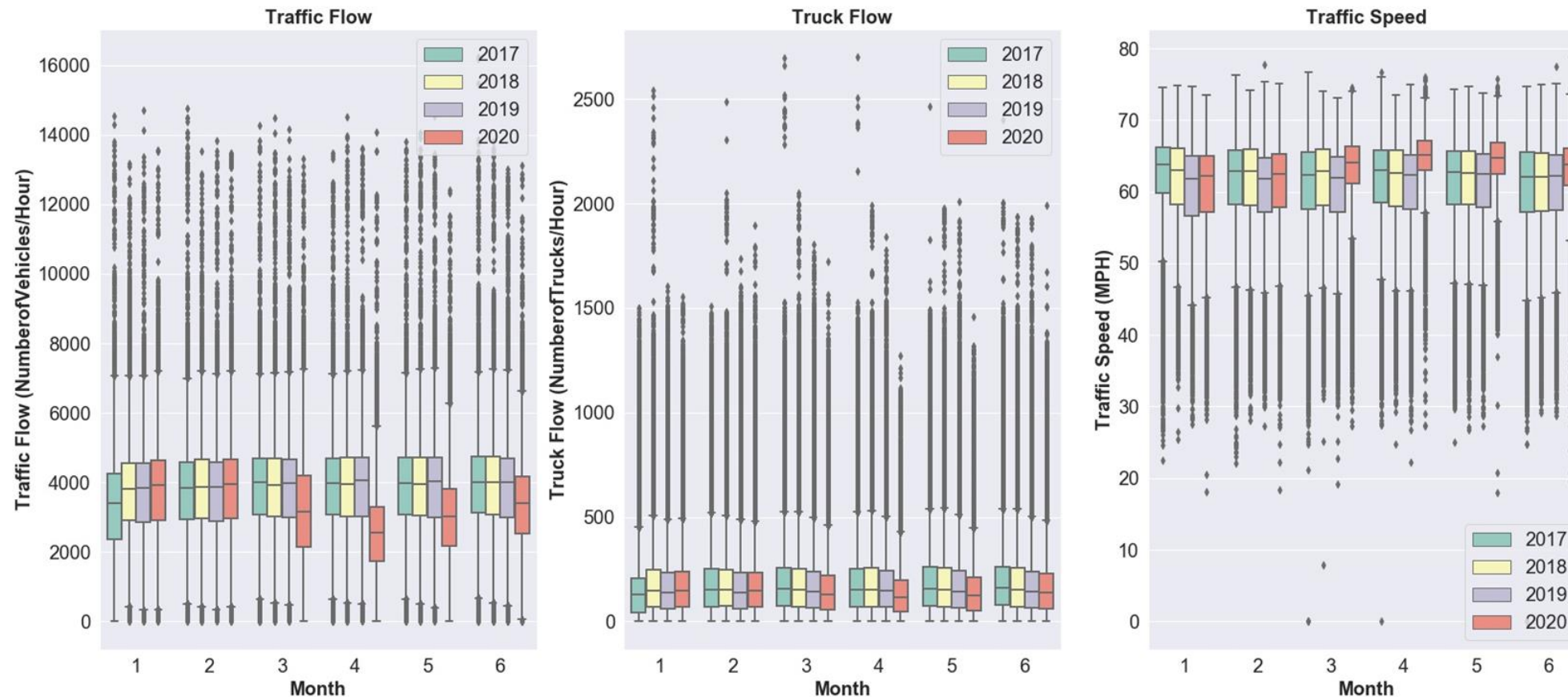
1. Before Saturday March 14, 2020 (Day of Year: 74) the NO₂ and CO concentration were generally larger than the same period in 2017-2019.
2. Starting from March 15, 2020 the NO₂ and CO concentration were generally less than during the same period in 2017-2019.
3. The shifts in NO₂ and CO trends share the same timing due to the impact of the lockdown.
4. Before March 7, 2020 Saturday (Day of Year: 67) the PM_{2.5} concentration in 2020 was generally larger than the same period in 2017-2019. Starting from March 8, 2020 the PM_{2.5} concentration in 2020 is generally less than the same period in 2017-2019. The timing of the shift for PM_{2.5} behavior during 2020 relative to 2017-2019 was one week ahead of that for NO₂, CO and traffic, potentially indicating the importance of a different source for PM_{2.5} than for the other pollutants
5. The ozone trend has been increased from Jan to April as is expected; Ozone trend has been decreased during lockdown period due to the decrease of NO_x;
6. NO_x and CO started resuming back as the traffic started resuming on April 14, 2020 (Day of Year: 105).
7. PM_{2.5} started resuming back on early on May.

Meteorology Pattern between 2017-2019 to 2020

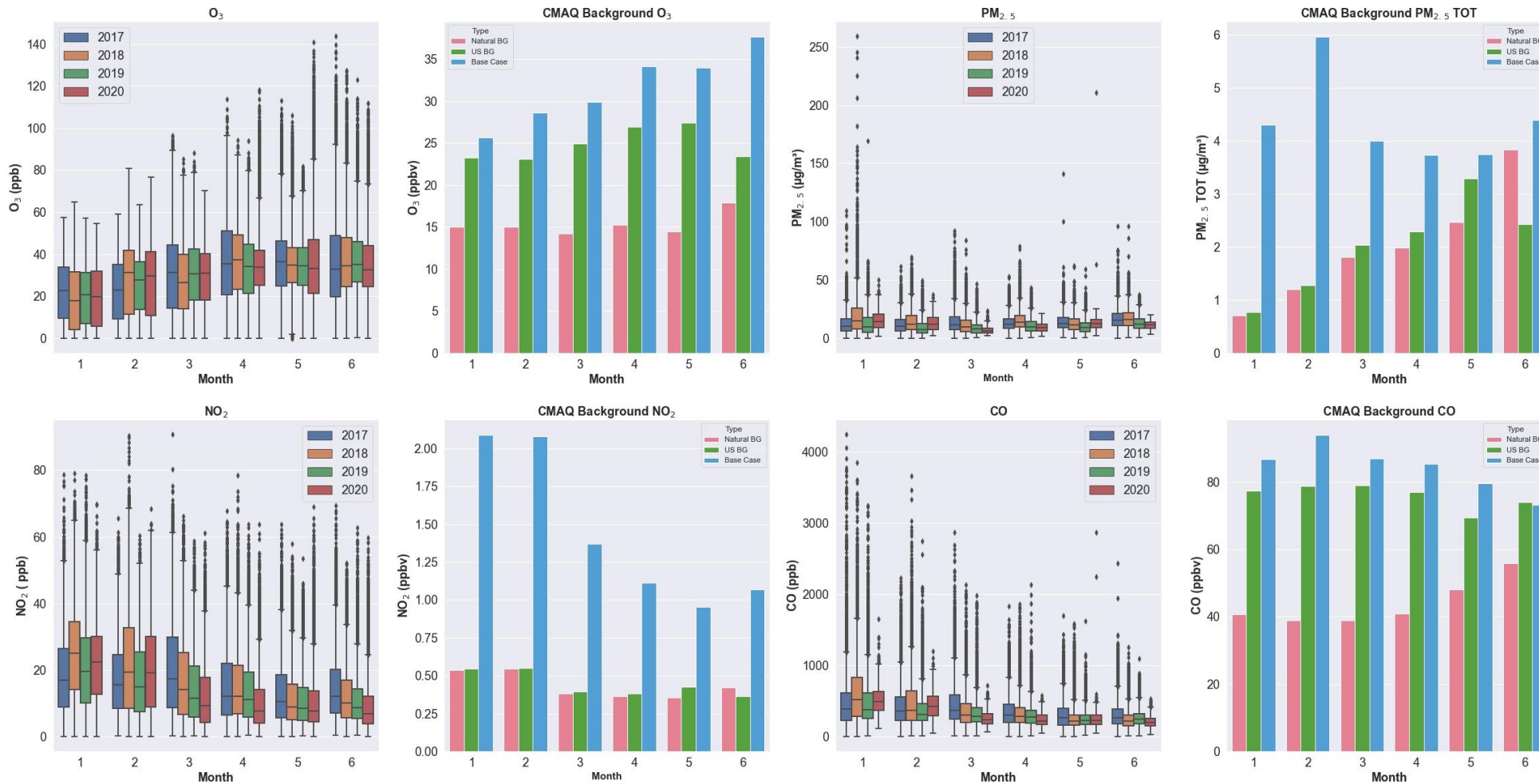


Box Plots for Traffic Patterns

Yang et al, 2020



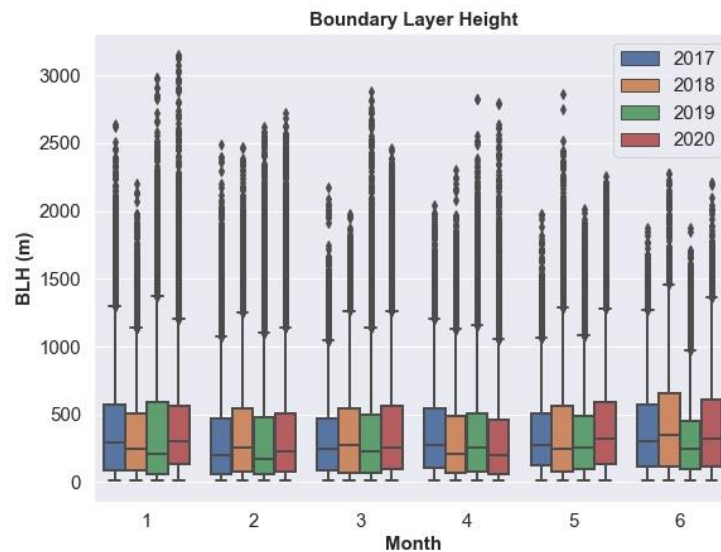
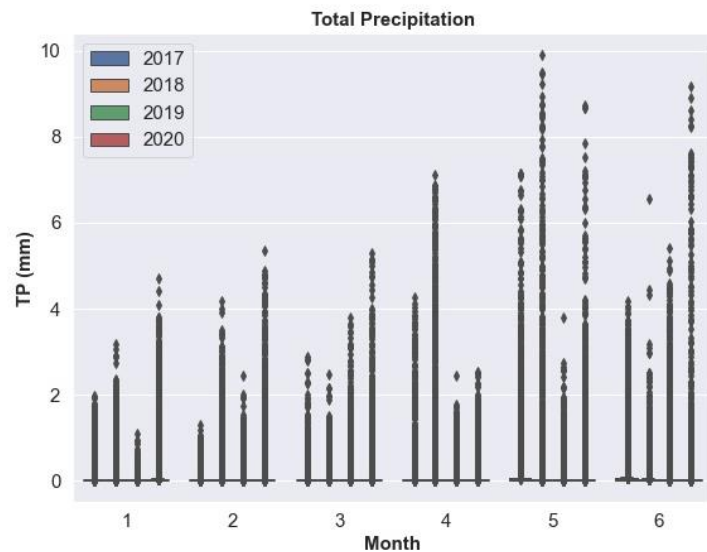
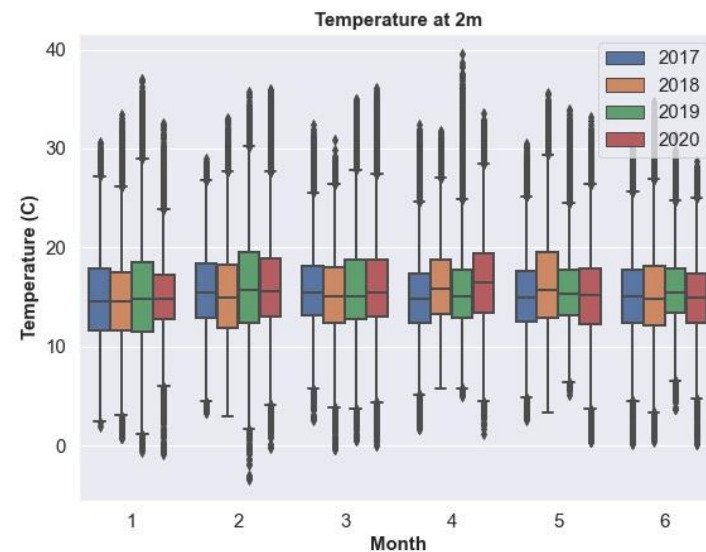
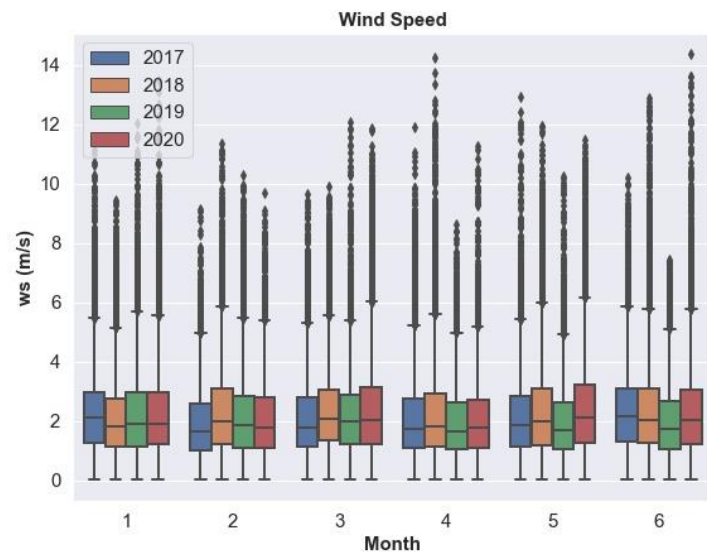
Values outside the interquartile range (indicated by the boxes) are shown as whiskers. traffic flow plot is relatively tall suggests the traffic situation varies with location and by day. The long interquartile range in traffic flow, truck flow and traffic speed indicate that there are some traffic hotspots in specific locations and time



There is a difference between 2017-2019 and 2020 during the March and June in box plots in terms of PM_{2.5}, NO₂, and CO which indicated there is unusual difference between those two groups due to the lockdown. The O₃ plots between 2020 and 2017-2019 have similar size and median and both are evenly distributed indicated the difference between those 2 groups are similar. During Jan and Feb, all figures have similar median, but are slightly different in terms of distribution, which means further investigation need to be initiated to understand the trend at the micro level.

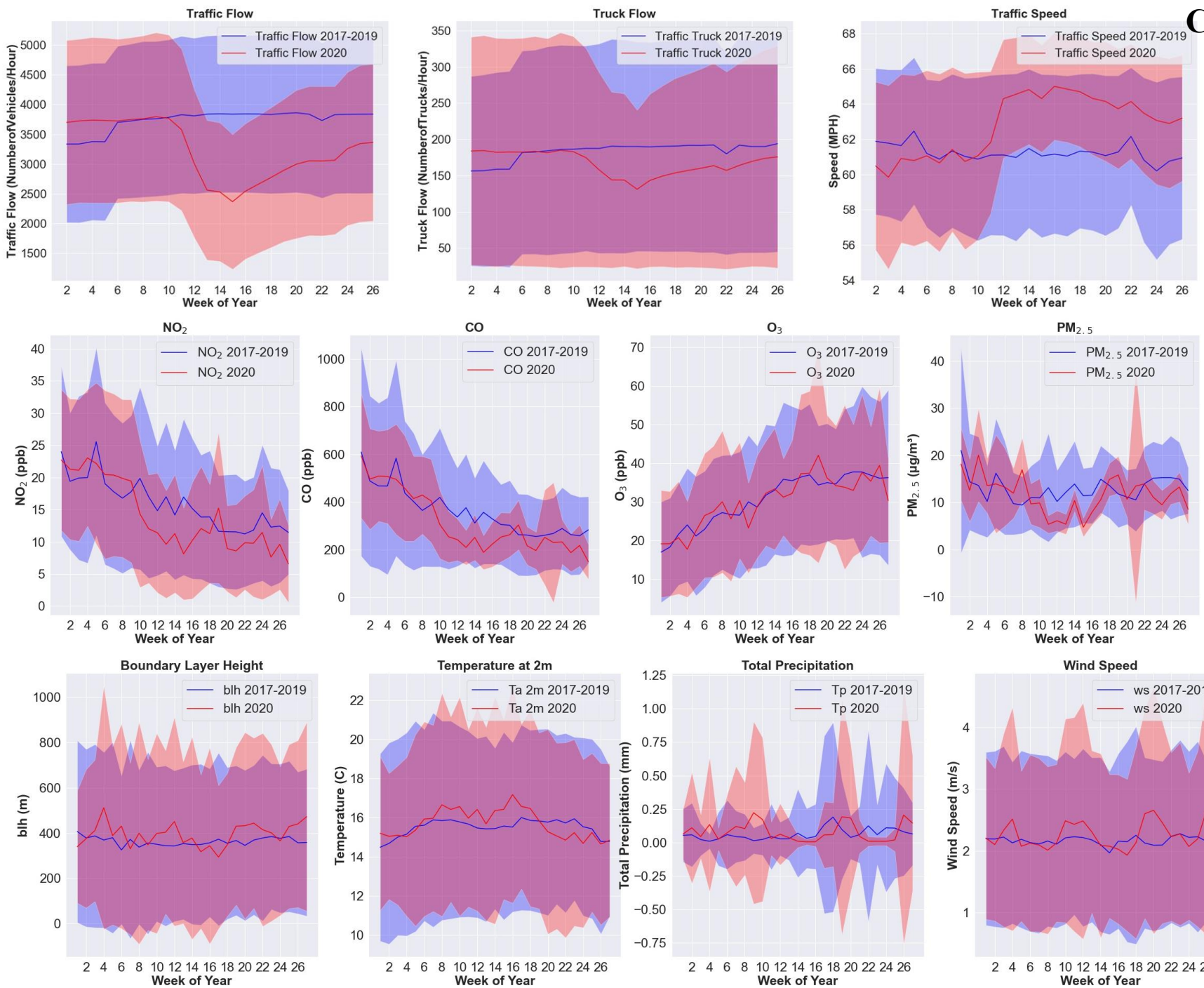
Base case (all natural + anthro sources everywhere)
US BG (no anthro sources in US; anthro everywhere else)
Natural BG (no anthro sources anywhere in NH)

Box Plots for Meteorology Pattern



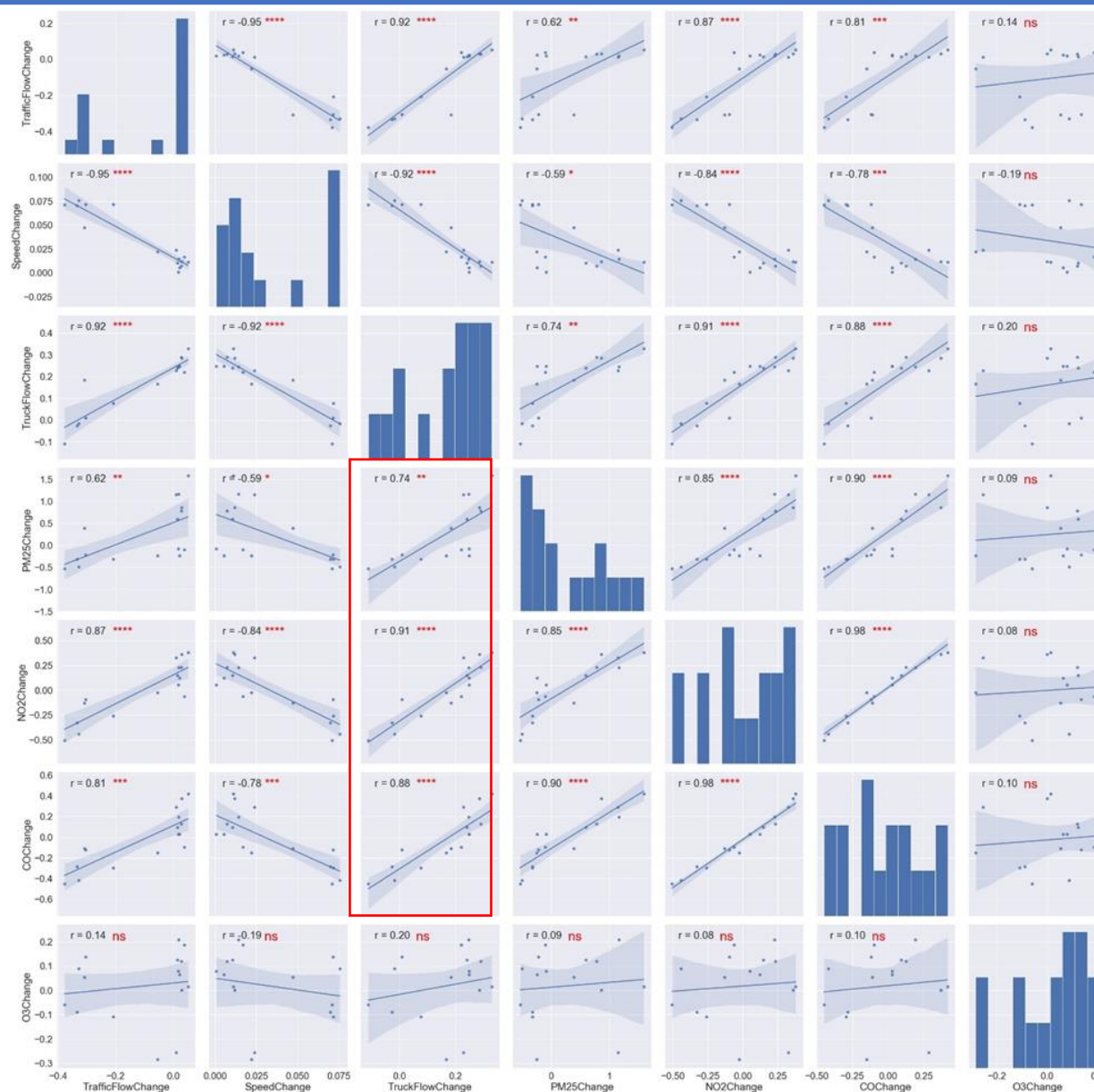
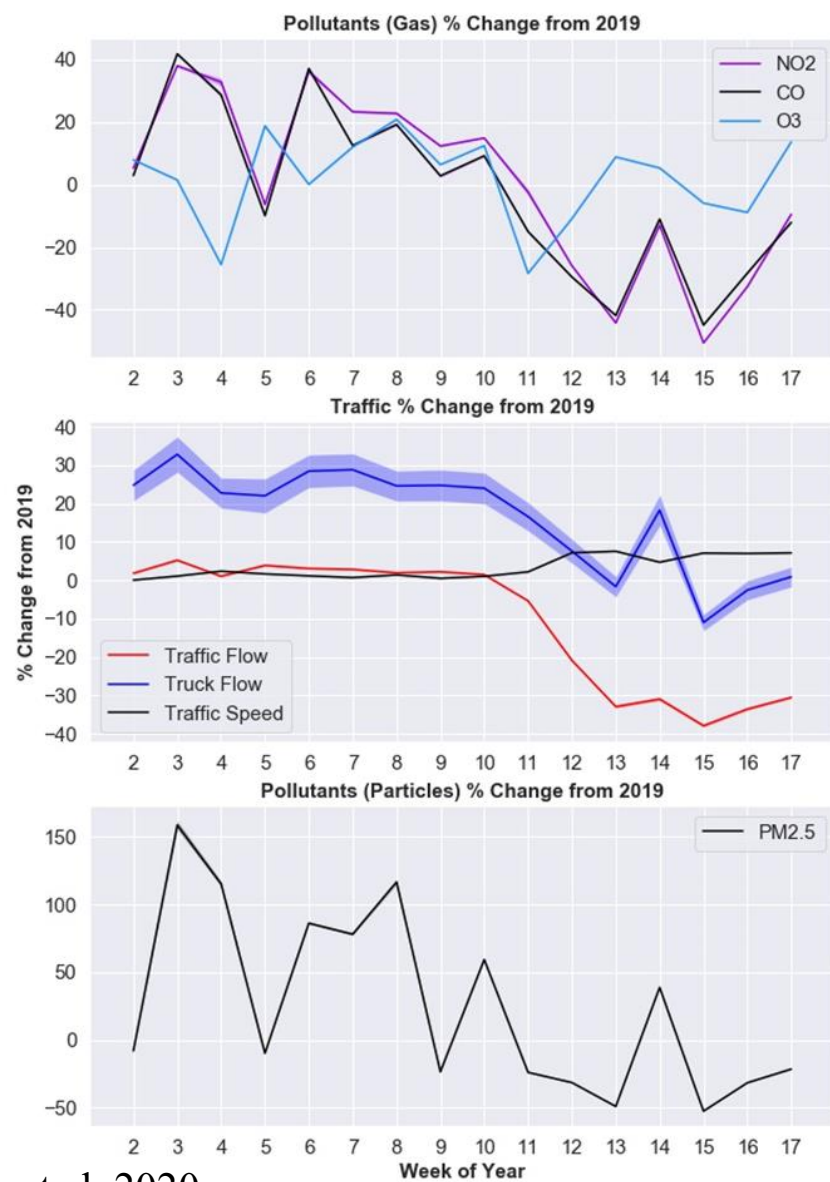
Values outside the interquartile range (indicated by the boxes) are shown as whiskers, which refers to time and spatial variability.

Weekly Pattern



The Average Weekly Percentage Change between 2019 and 2020 (Jan to Apr)

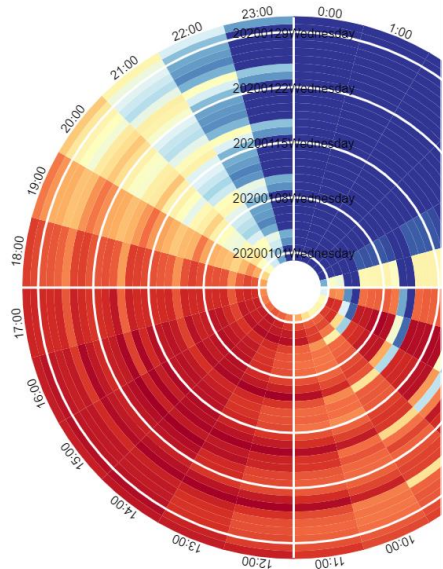
CMAS Conference 2020



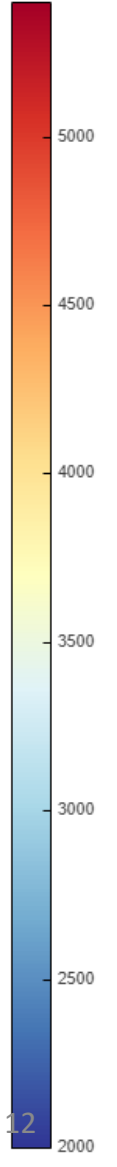
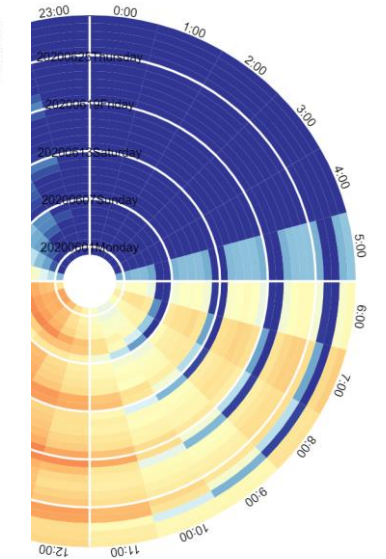
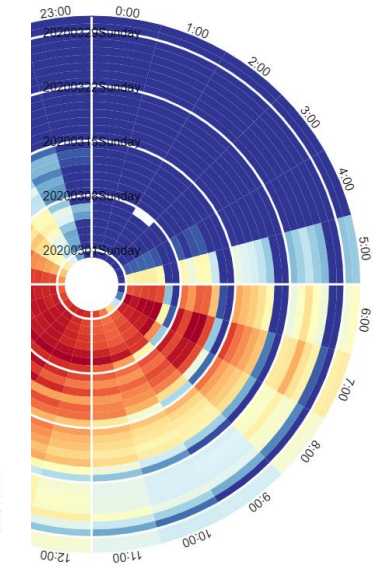
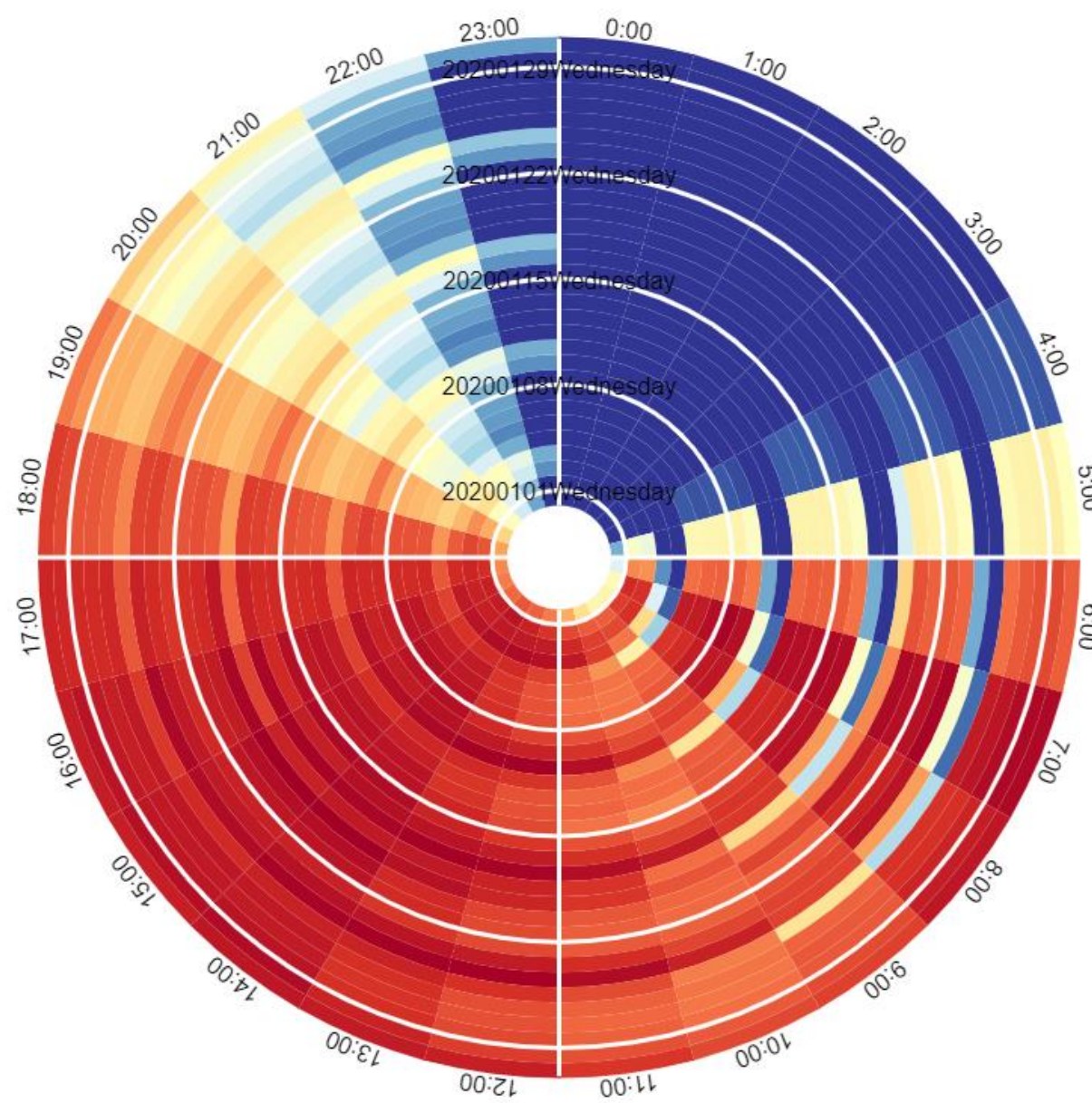
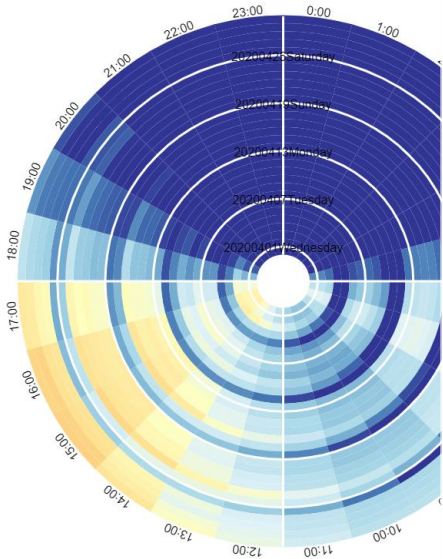
24-hour Average Pattern for Traffic Flow (Jan to Jun 2020)

LA Basin Traffic Flow 2020 Jan

LA Basin Traffic Flow 2020 Jan

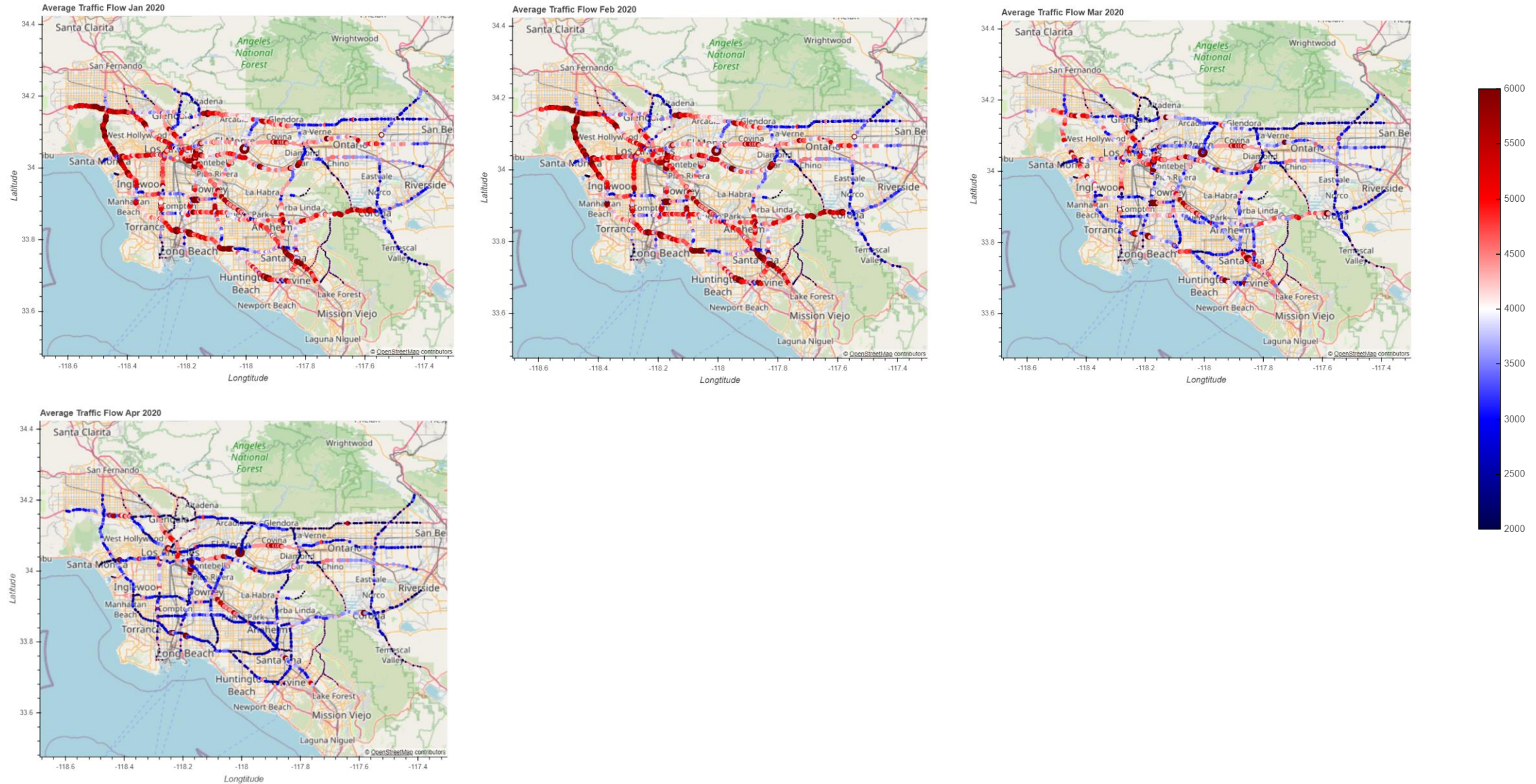


LA Basin Traffic Flow 2020 Apr



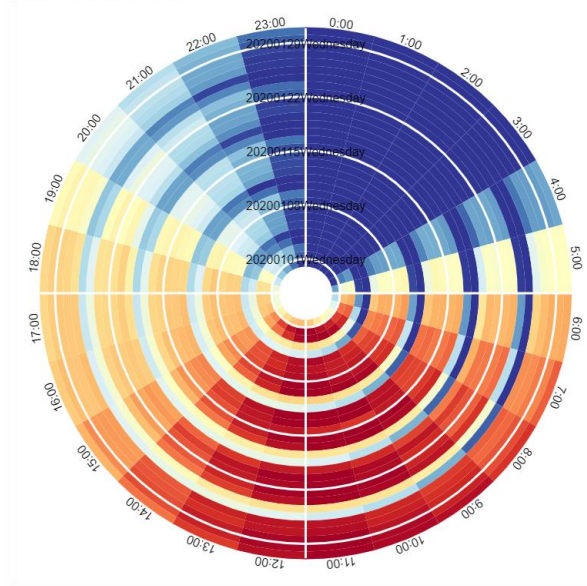
Spatial Monthly Average Pattern for Traffic Flow (Jan to Apr 2020)

Yang et al, 2020

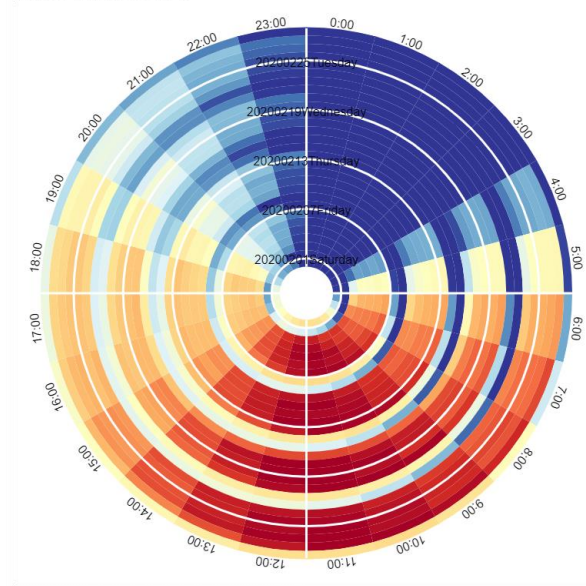


24-hour Average Pattern for Truck Flow (Jan to Jun 2020)

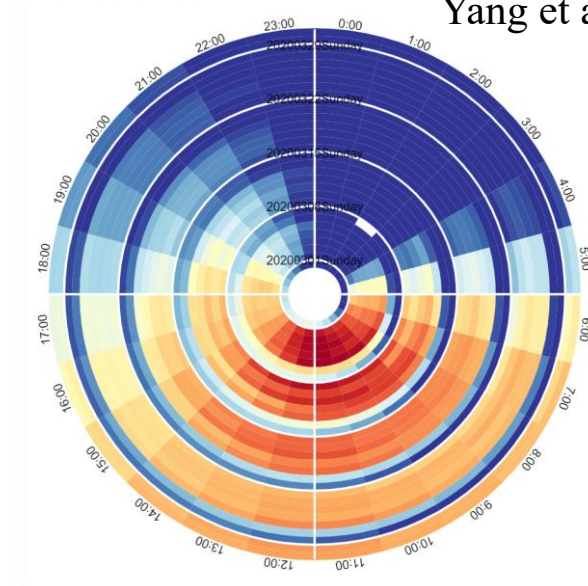
LA Basin Truck Flow 2020 Jan



LA Basin Truck Flow 2020 Feb

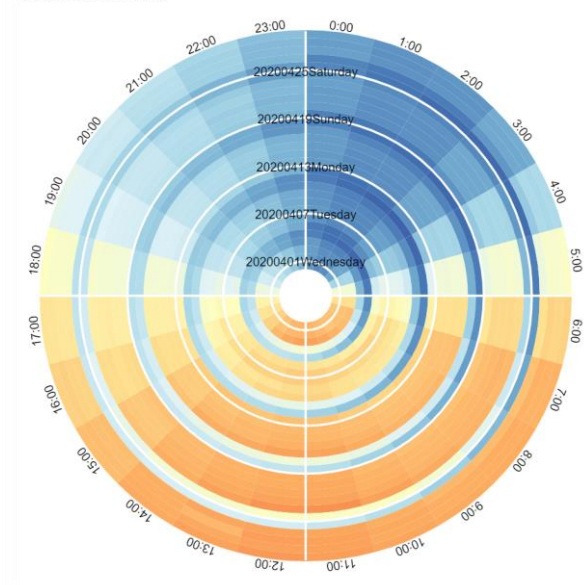


LA Basin Truck Flow 2020 Mar

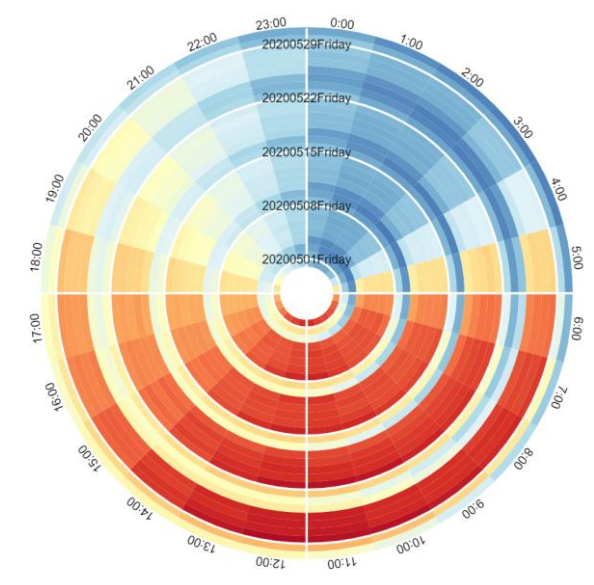


Yang et al, 2020

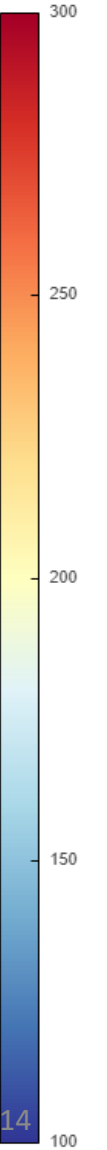
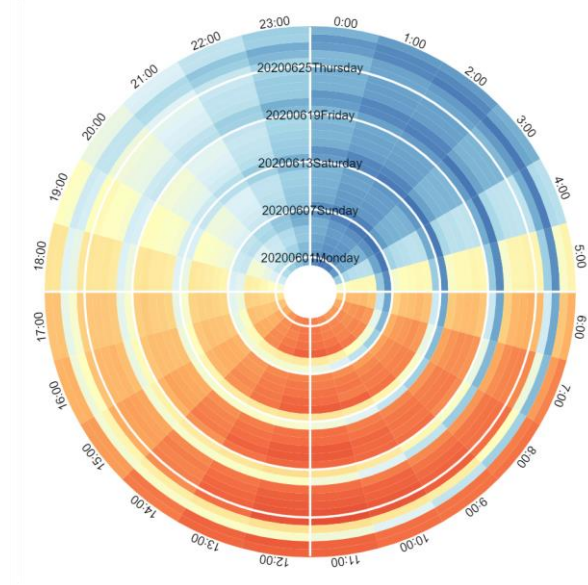
LA Basin Truck Flow 2020 April



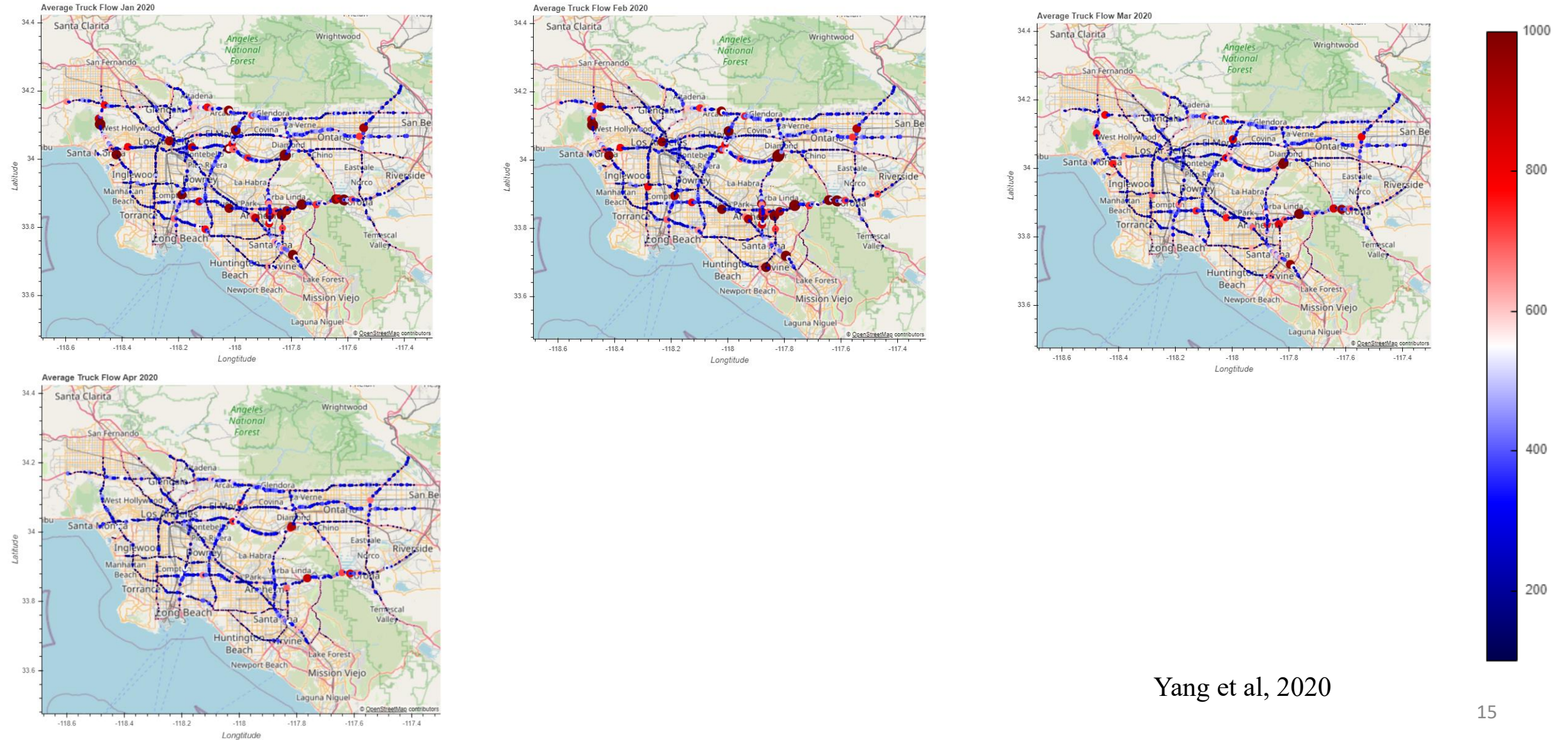
LA Basin Truck Flow 2020 May



LA Basin Truck Flow 2020 Jun



Spatial Monthly Average Pattern for Truck Flow (Jan to Apr 2020)

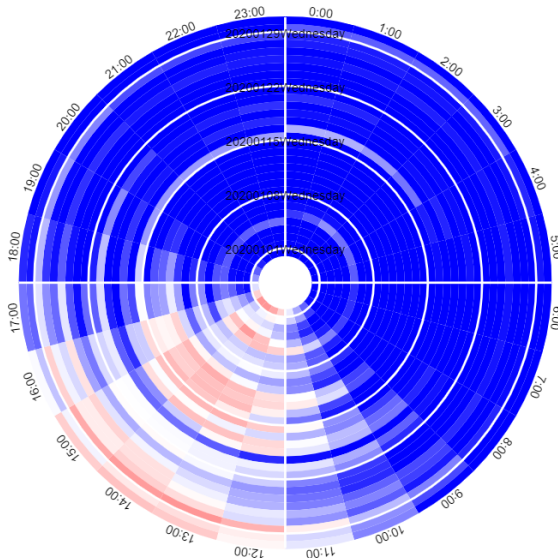


Yang et al, 2020

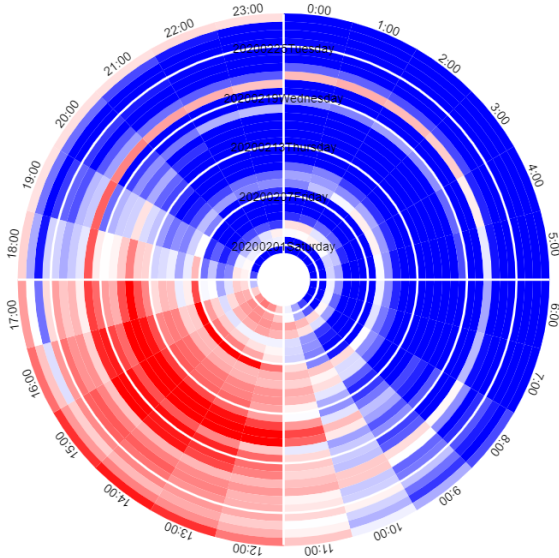
24-hour Average Pattern for O3 and NO2 (Jan to Apr 2020)

Yang et al, 2020

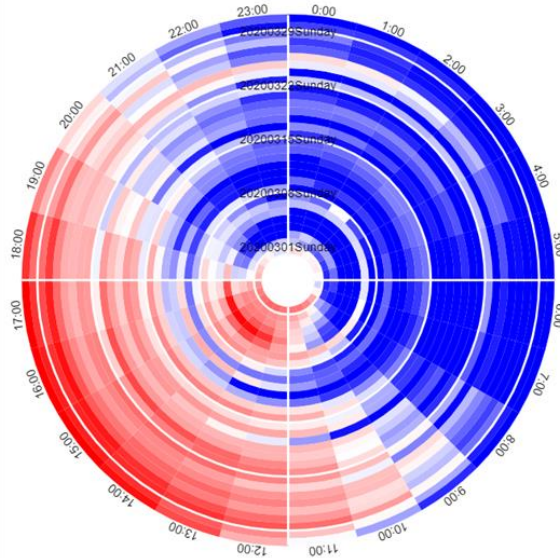
O3 2020 Jan



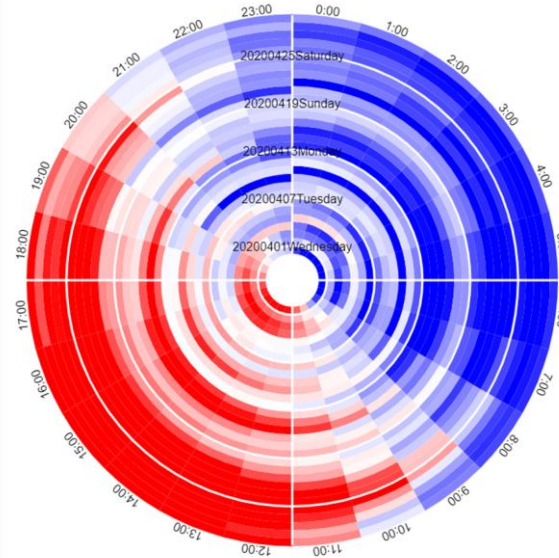
O3 2020 Feb



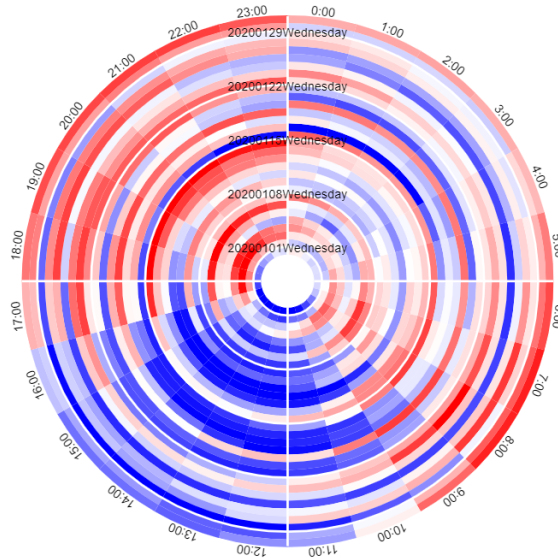
O3 2020 Mar



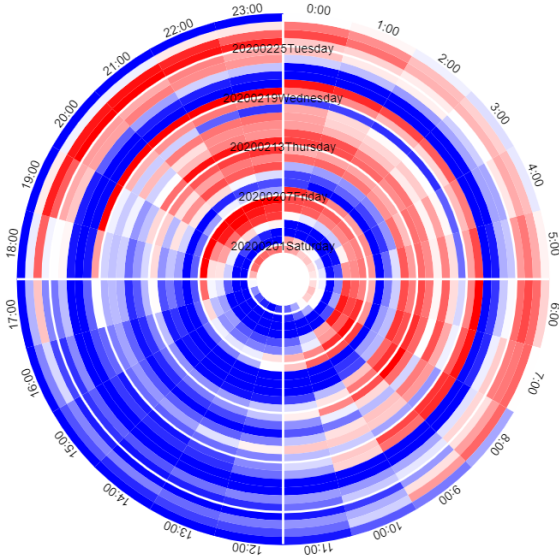
O3 2020 Apr



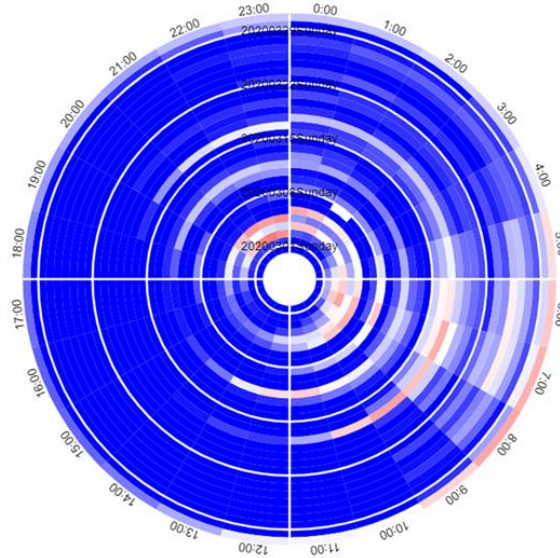
NO2 2020 Jan



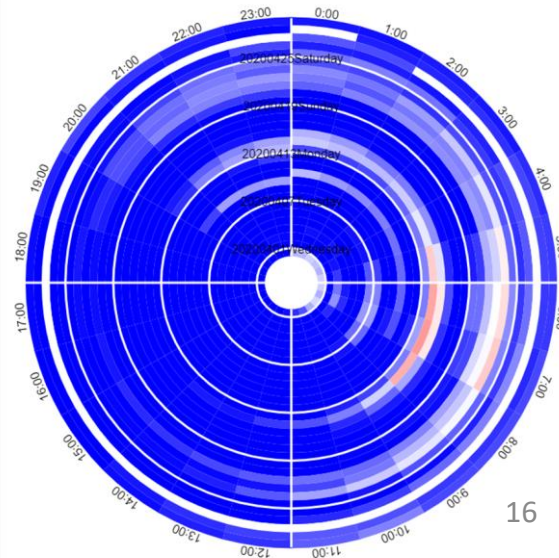
NO2 2020 Feb



NO2 2020 Mar



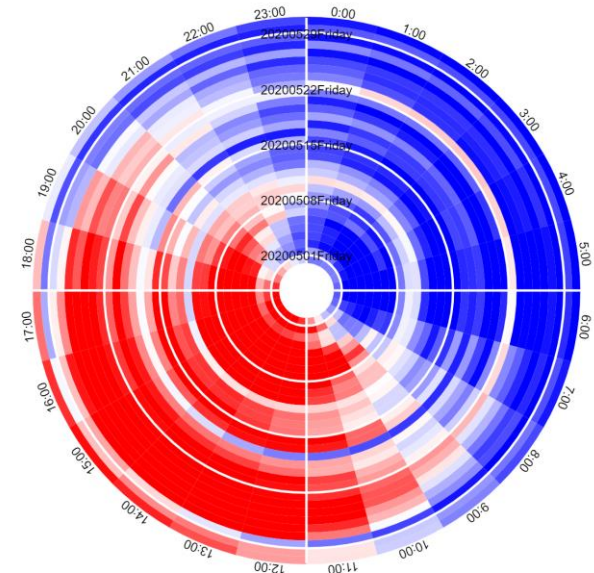
NO2 2020 Apr



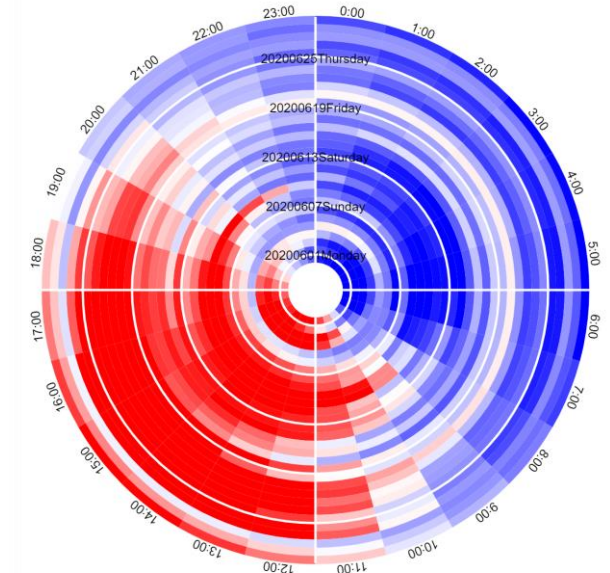
24-hour Average Pattern for Traffic Speed (May to Jun 2020)

Yang et al, 2020

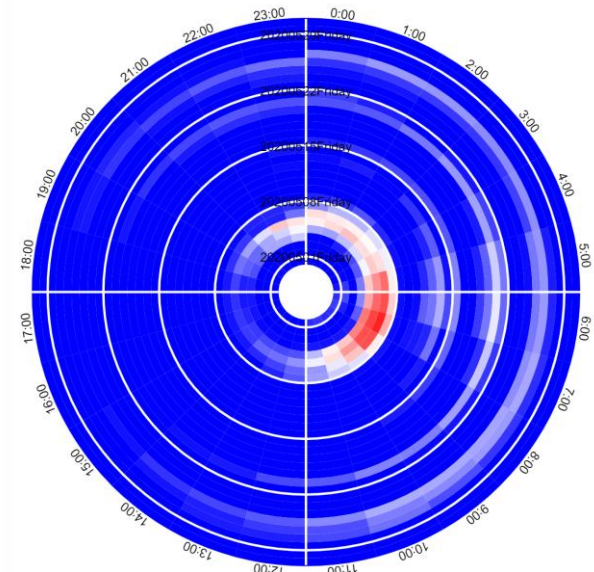
O3 2019 May



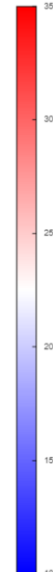
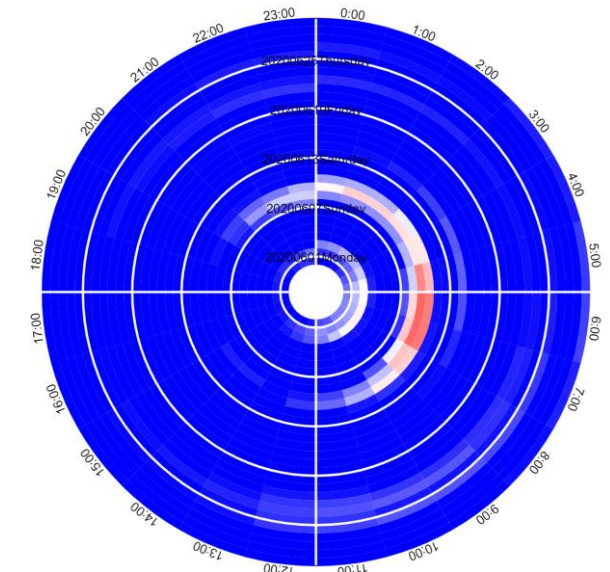
O3 2019 Jun



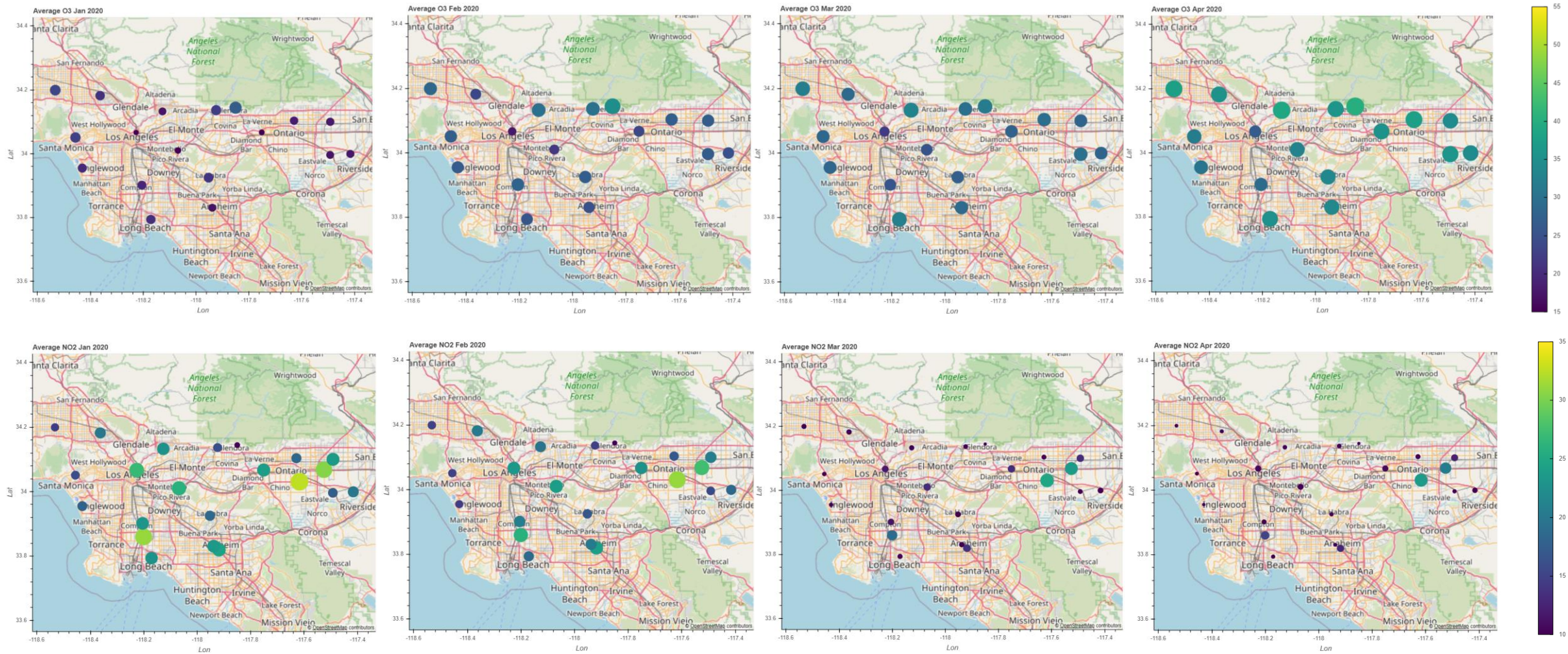
NO2 2020 May



NO2 2020 Jun



Spatial Monthly Average Pattern for O3 and NO2 (Jan to Apr 2020)



Yang et al, 2020

2. Improvement of the Air Quality in the LA Basin during the COVID-19 Outbreak based on Real-Time Data and Machine Learning



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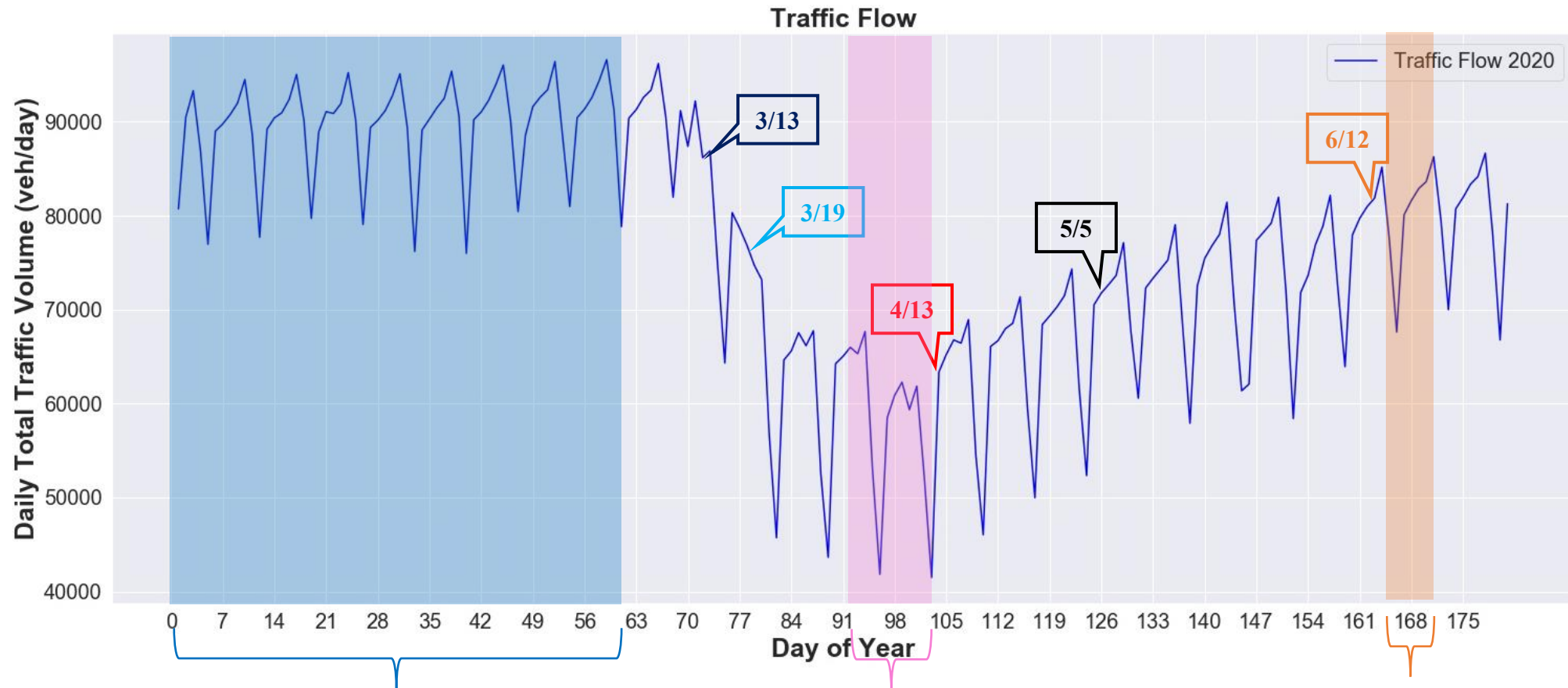


Prof. John Seinfeld
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Prof. Yuk Yung
CalTech

3 Scenarios for Traffic Patterns in 2020



Scenario 1 : Pre-COVID-19 (Jan 1 to Mar 3)

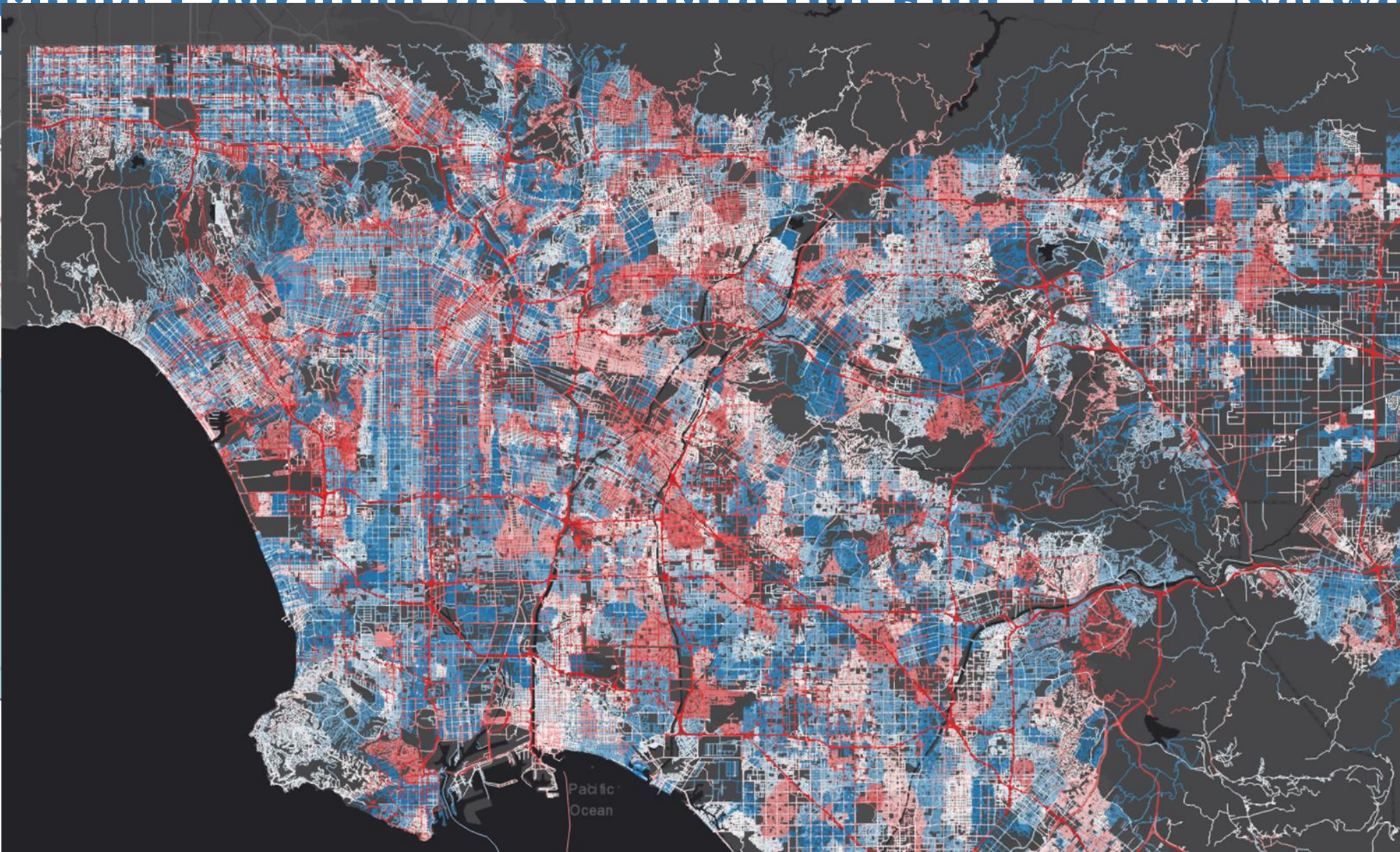
Scenario 2 : Early-COVID-19 (Apr 1 to Apr 12)

Scenario 3 : Late-COVID-19 (Jun 12 to Jun 18)

- March 4 (Day of Year:64): Governor Gavin Newsom declares a state of emergency in California
- March 13 (Day of Year:73): President Trump declares a national emergency
- March 19 (Day of Year:79): Gov. Gavin Newsom announces a statewide order to shelter in place
- April 13 (Day of Year:104): Gov. Gavin Newsom announces that a gradual plan to lift shelter in place orders in California
- May 5 (Day of Year:126): California enters stage two which relaxes some of the shelter in place restrictions. (restaurants etc. re-open)
- Jun 12 (Day of Year:164): Stage 3: Statewide, movie theaters, restaurants, wineries, bars, zoos, museums, gyms, fitness centers, hotels, cardrooms, racetracks, and campgrounds are allowed to reopen

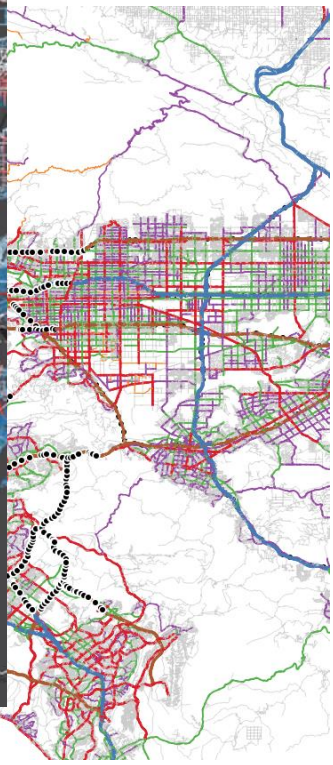
Machine Learning to Simulate the Full Traffic Network

Ave
34.4
34.2
34
bu
Latitude
33.8
33.6

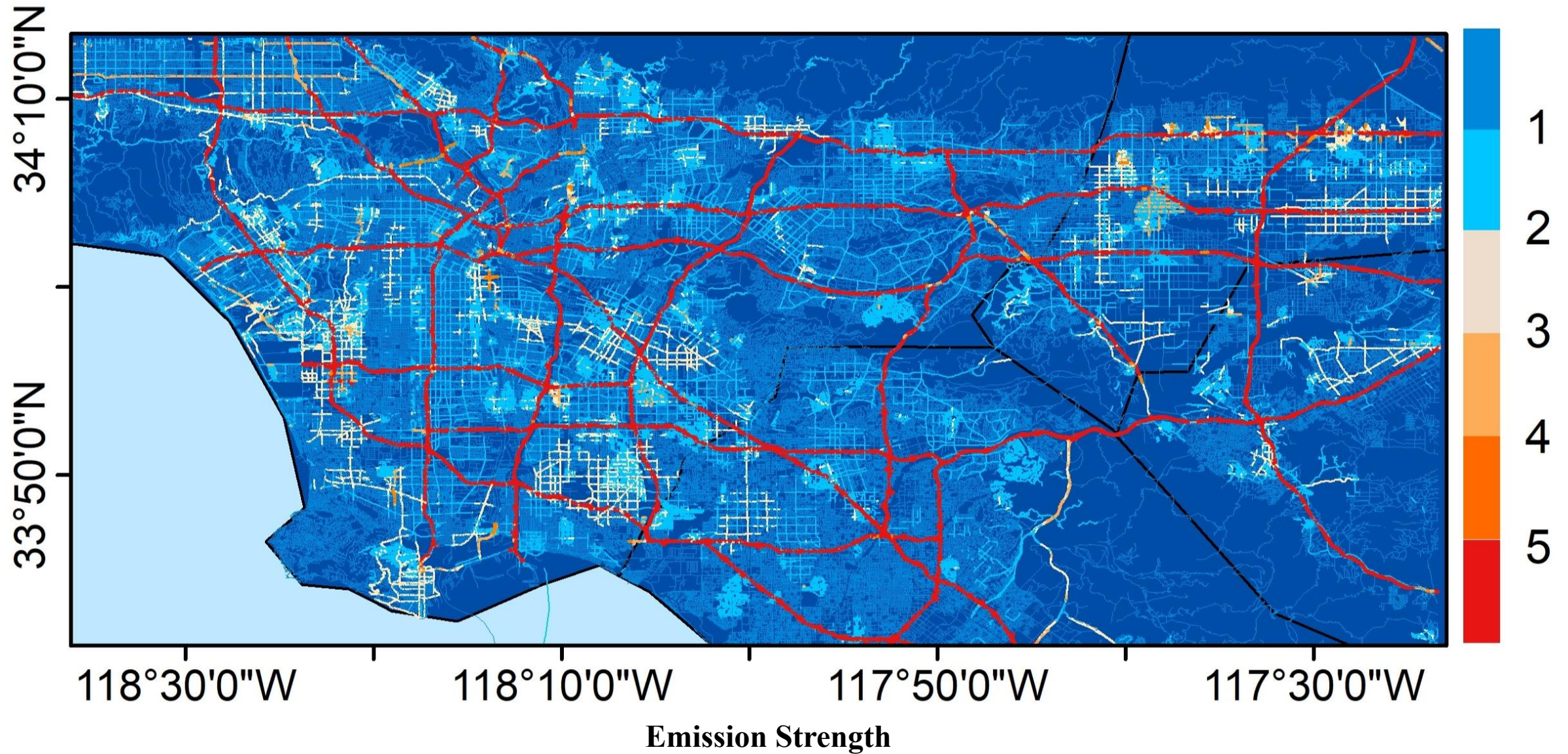


Freeway or Expressway	1
Principal Arterial	2
Arterial	3
Collector	4
Collector	5
	6
	7

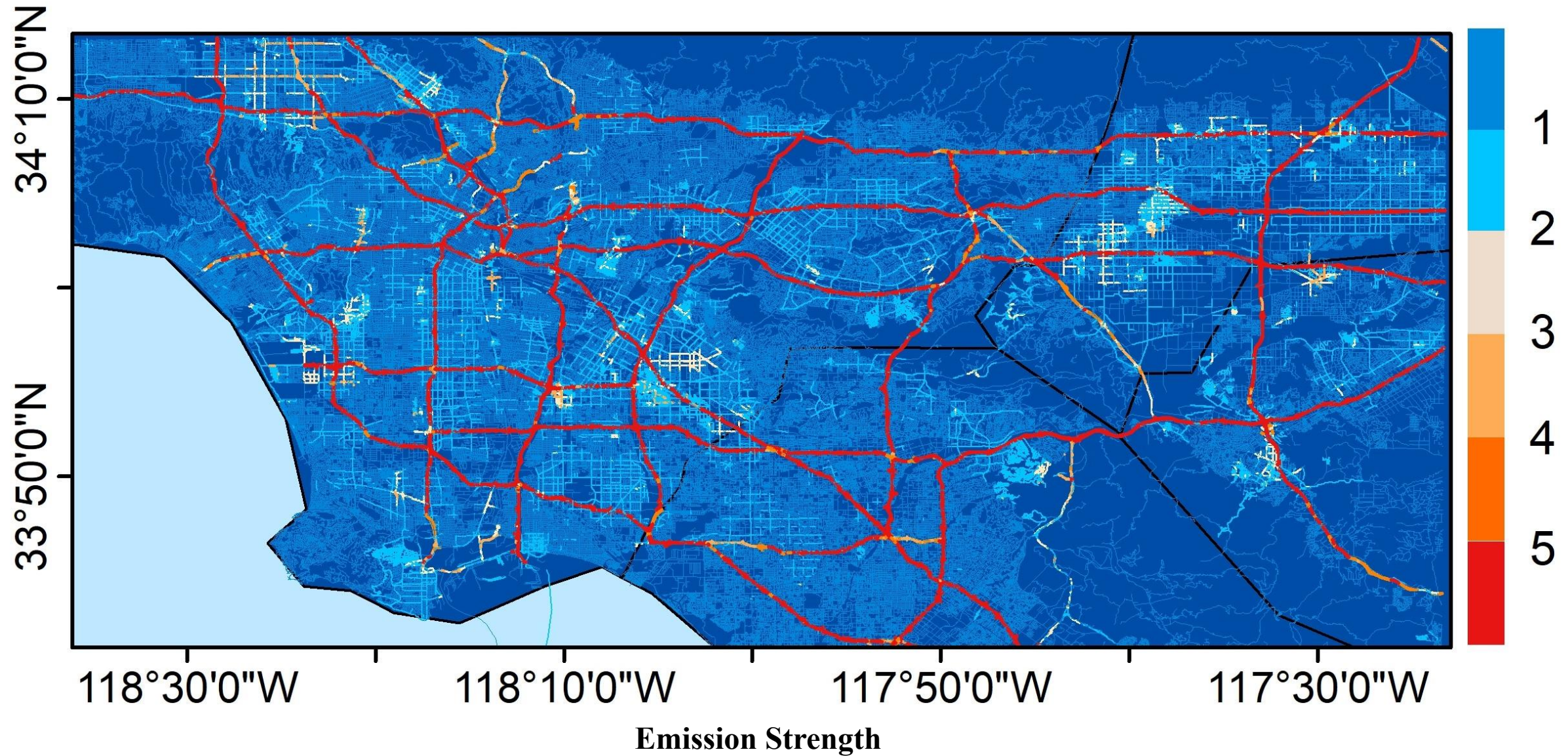
✓ District 07 D07
□ District 06 D06
□ District 09 D09



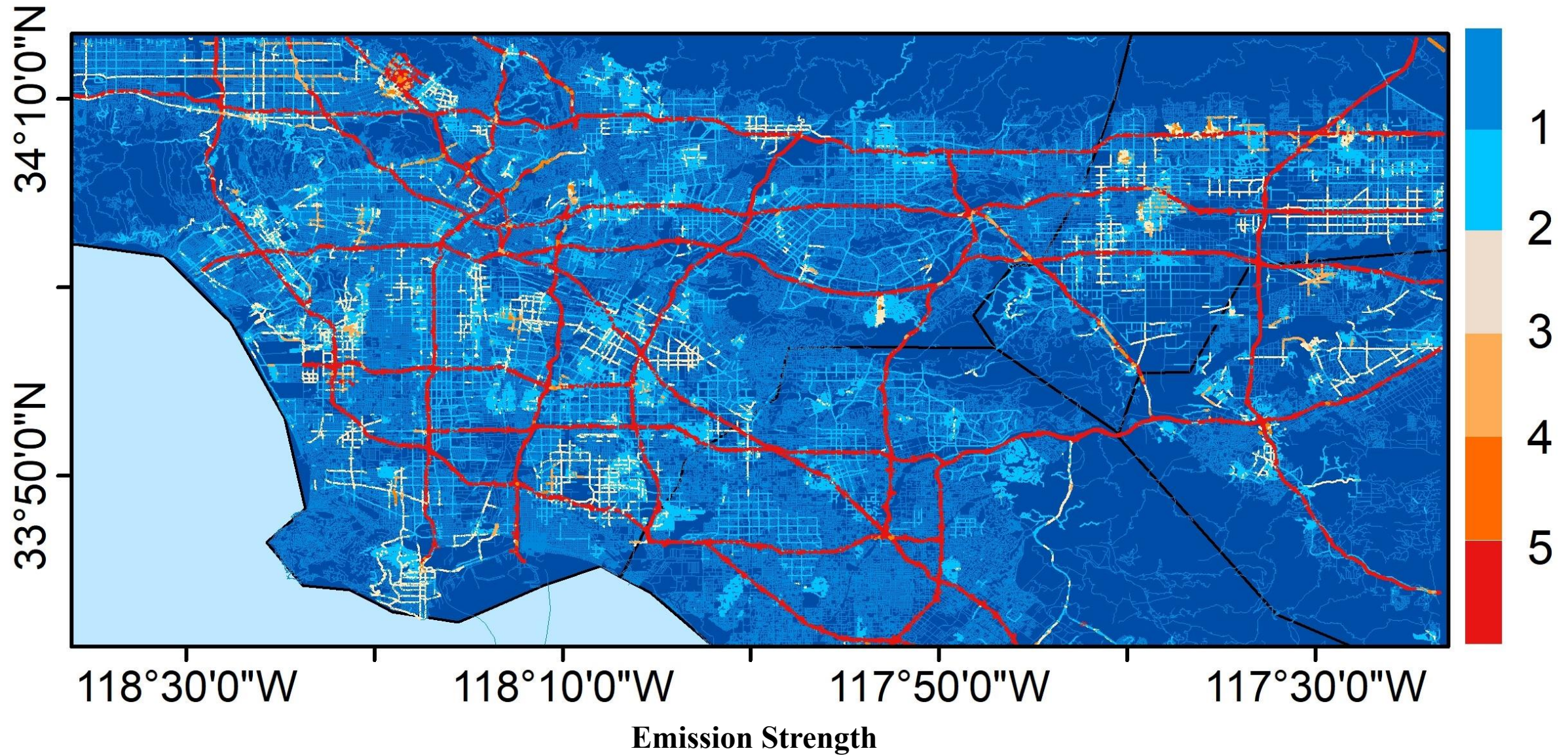
Full Traffic Network Emission - Scenario 1 : Pre-COVID-19 (Jan 1 to Mar 3)



Full Traffic Network Emission - Scenario 2 : Early-COVID-19 (Apr 1 to Apr 12)



Full Traffic Network Emission - Scenario 3 : Late-COVID-19 (Jun 12 to Jun 18)



Thank you!

