Comparison of 2020 Nitrogen Oxides and Fine Particle Concentrations in New Jersey with Data from 2014-2019

The Impact of the “Stay at Home” Directive on Air Quality in New Jersey

NJDEP Bureau of Air Monitoring

Updated 2/4/2021

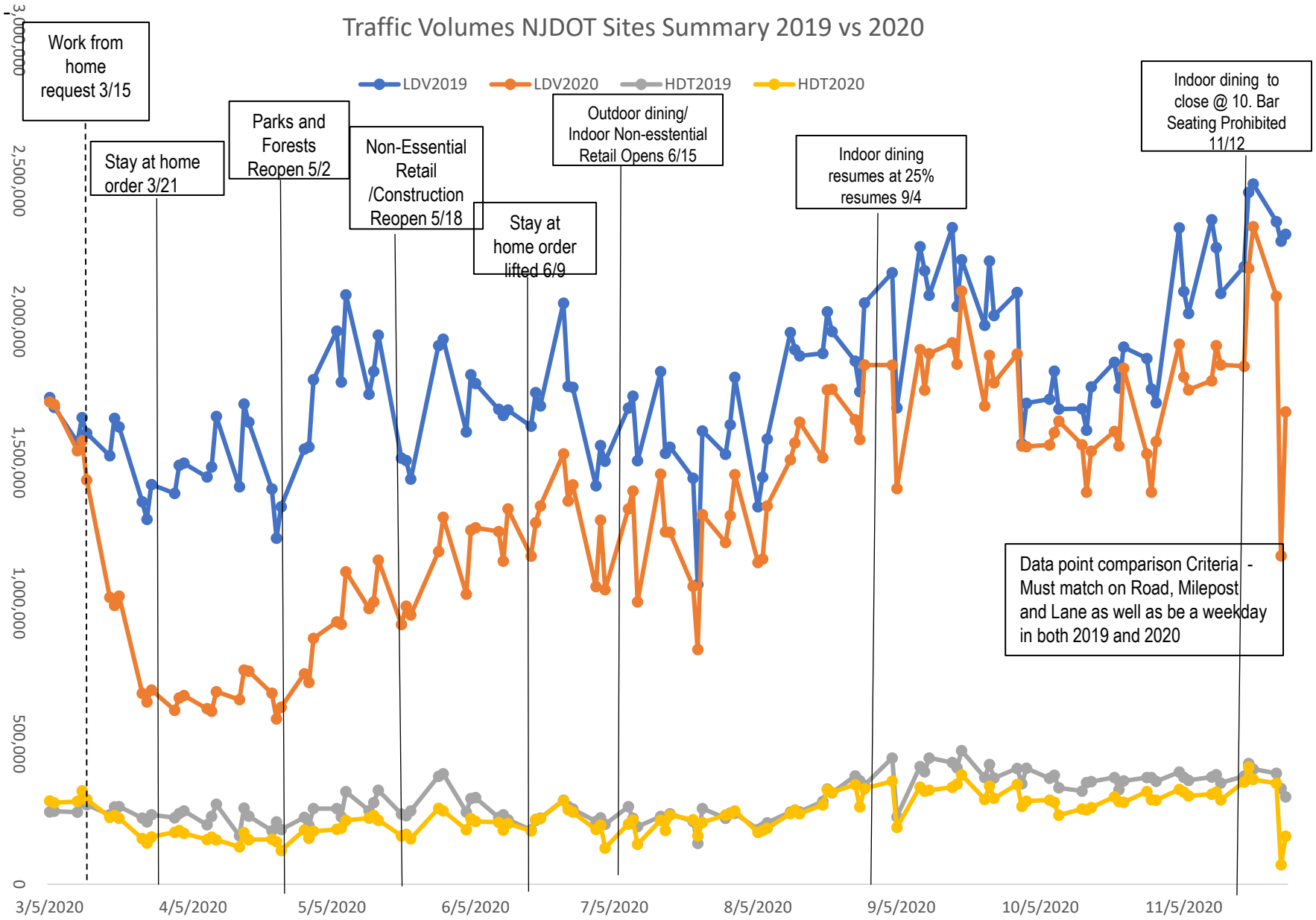
Stay at Home: Executive Order 107, 3/21/20

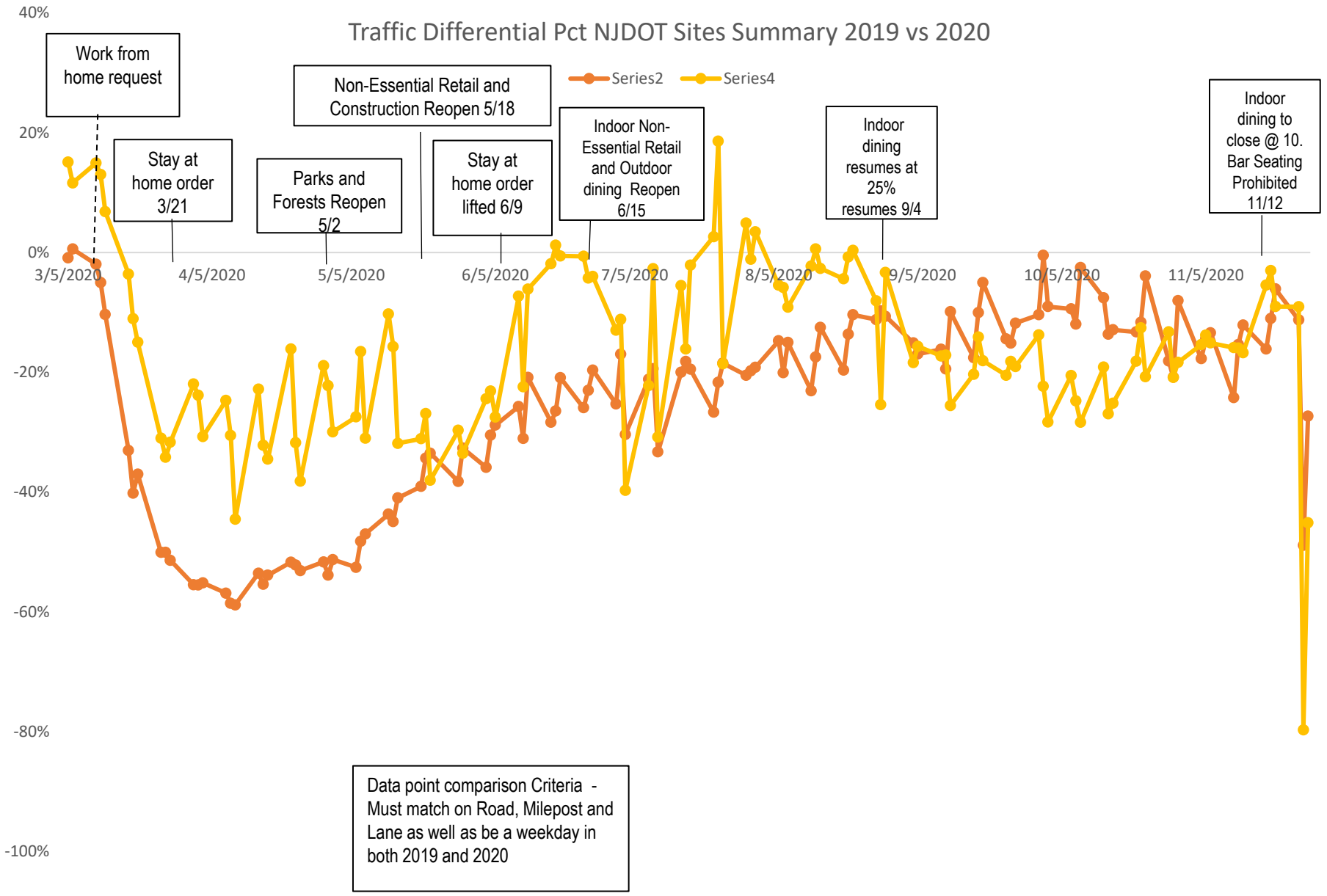
- Office workers work from home.
- All schools and colleges closed; study from home.
- Closure of all non-essential retail businesses
- Closure of all recreational and entertainment businesses.
- All non-essential construction projects must stop.
- Restrictions eased on 5/18/20 (Stage 1) and 6/15/20 (Stage 2)

Results by end of March 2020:

- 50% reduction in light duty vehicle traffic
- 30% reduction in heavy duty vehicle traffic
- 5%-14% reduction in power use (b,c)

7:30 -


Traffic Volumes NJDOT Sites Summary 2019 vs 2020
LDV2019
LDV2020
HDT2019
HDT2020
Work from home request 3/15
Stay at home order 3/21
Parks and Forests Reopen 5/2
Non-Essential Retail /Construction Reopen 5/18
Stay at home order lifted 6/9
Outdoor dining/ Indoor Non-esstential Retail Opens 6/15
Indoor dining resumes at 25% resumes 9/4
Indoor dining to close @ 10. Bar Seating Prohibited 11/12
Data point comparison Criteria - Must match on Road, Milepost and Lane as well as be a weekday in both 2019 and 2020
3,000,000
2,500,000
2,000,000
1,500,000
1,000,000
500,000
0
3/5/2020
4/5/2020
5/5/2020
6/5/2020
7/5/2020
8/5/2020
9/5/2020
10/5/2020
11/5/2020

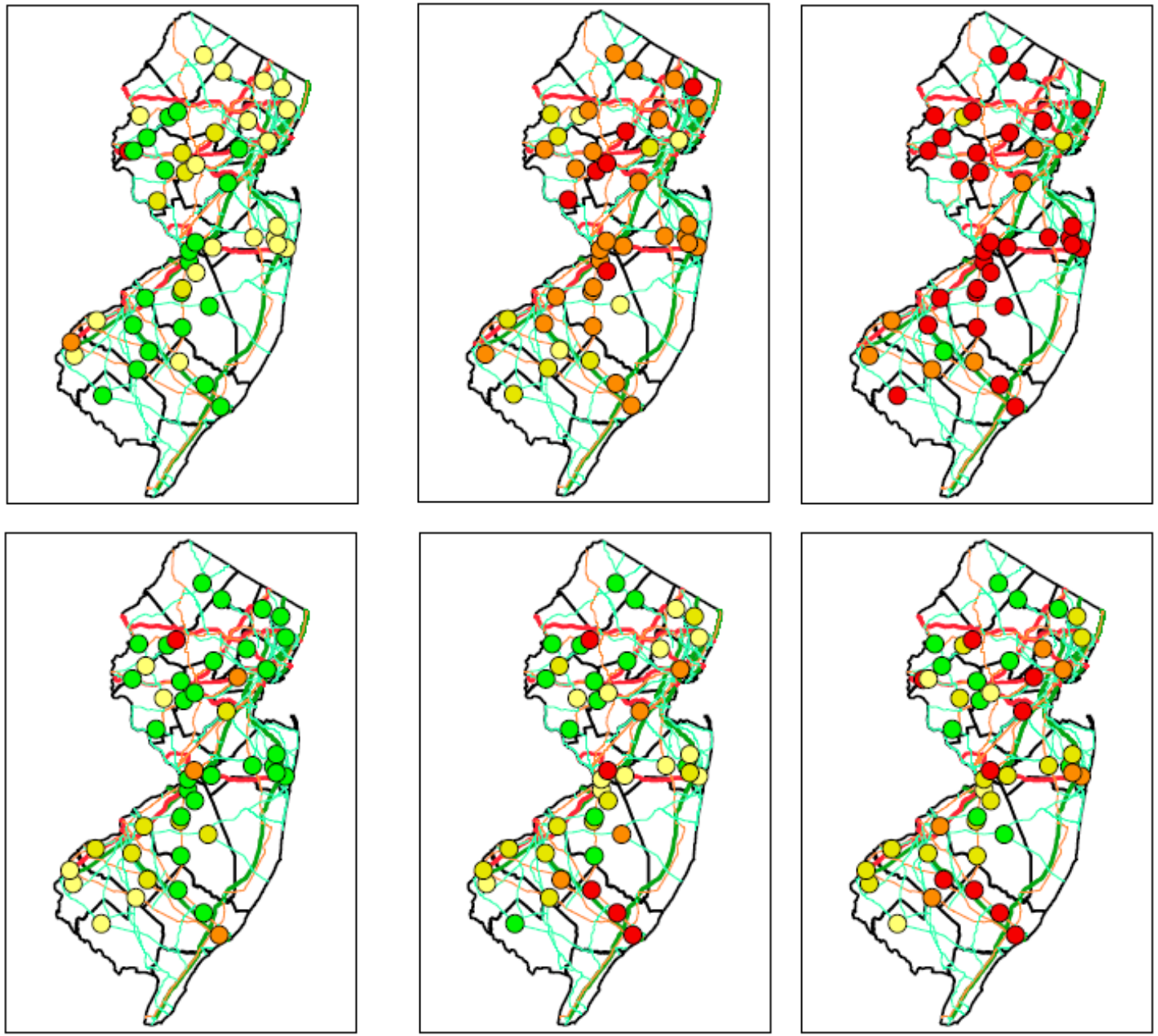

Traffic Differential Pct NJDOT Sites Summary 2019 vs 2020
Series2
Series4
Work from home request
Stay at home order 3/21
Parks and Forests Reopen 5/2
Non-Essential Retail and Construction Reopen 5/18
Stay at home order lifted 6/9
Indoor Non-Essential Retail and Outdoor dining Reopen 6/15
Indoor dining resumes at 25% resumes 9/4
Indoor dining to close @ 10. Bar Seating Prohibited 11/12
40%
20%
0%
-20%
-40%
-60%
-80%
-100%
3/5/2020
4/5/2020
5/5/2020
6/5/2020
7/5/2020
8/5/2020
9/5/2020
10/5/2020
11/5/2020
Data point comparison Criteria - Must match on Road, Milepost and Lane as well as be a weekday in both 2019 and 2020

Traffic Counts Comparison March 2019 - 2020

Pre Work From Home

Voluntary Work From Home

Mandatory Work From Home



Light Duty Vehicles

Heavy Duty Vehicles

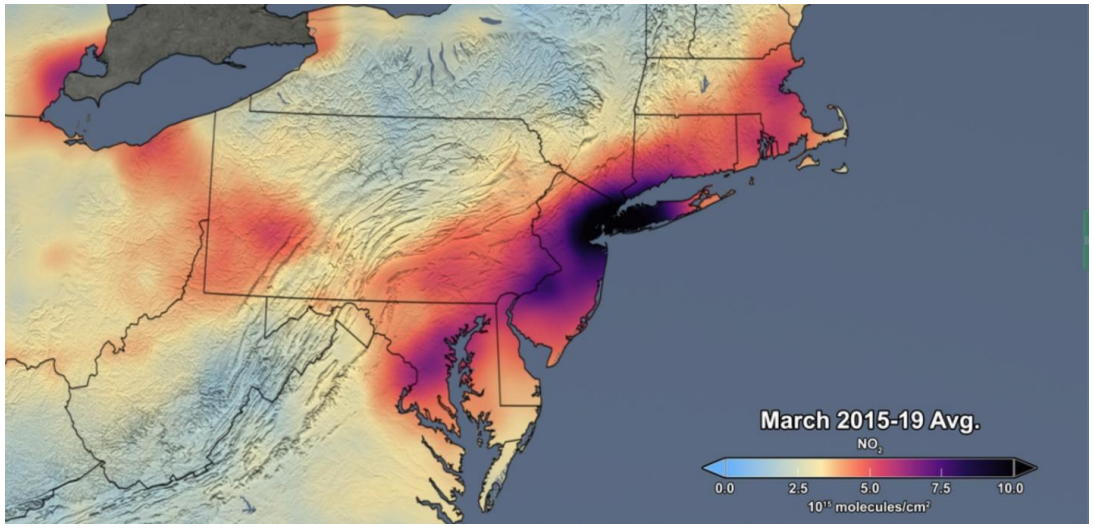
Legend

Traffic Volume Change 2019 - 2020

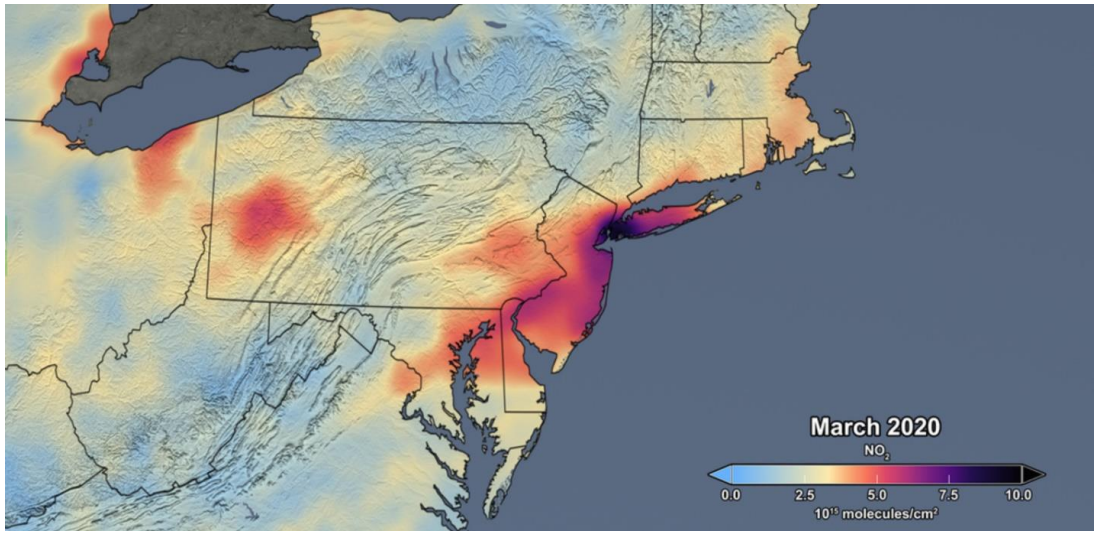
- Gain In Volume
- 0 - 15% Reduction
- 15 -30 Percent Reduction
- 30 - 45 Percent Reduction
- Greater than 45 Percent Reduction

Satellite Images of NO_2 Levels

NO_2 Levels, March 2015-2019



NO_2 Levels, March 2020



https://www.nasa.gov/feature/goddard/2020/drop-in-air-pollution-over-northeast

News Media Use Satellite Images to Promote Substantial Improvement in Air Quality

- "…[C]leanest since 9/11," https://www.nj.com/coronavirus/2020/04/njs-air-is-the-cleanest-its-been-since-911-due-to-coronavirus-shutdown.html
- "…[P]andemic response has cleared the air from LA to Wuhan," https://www.washingtonpost.com/weather/2020/04/09/air-quality-improving-coronavirus/
- "Reductions in traffic and industry have lowered nitrogen dioxide levels," https://www.wired.com/story/the-pandemic-has-led-to-a-huge-global-drop-in-air-pollution/

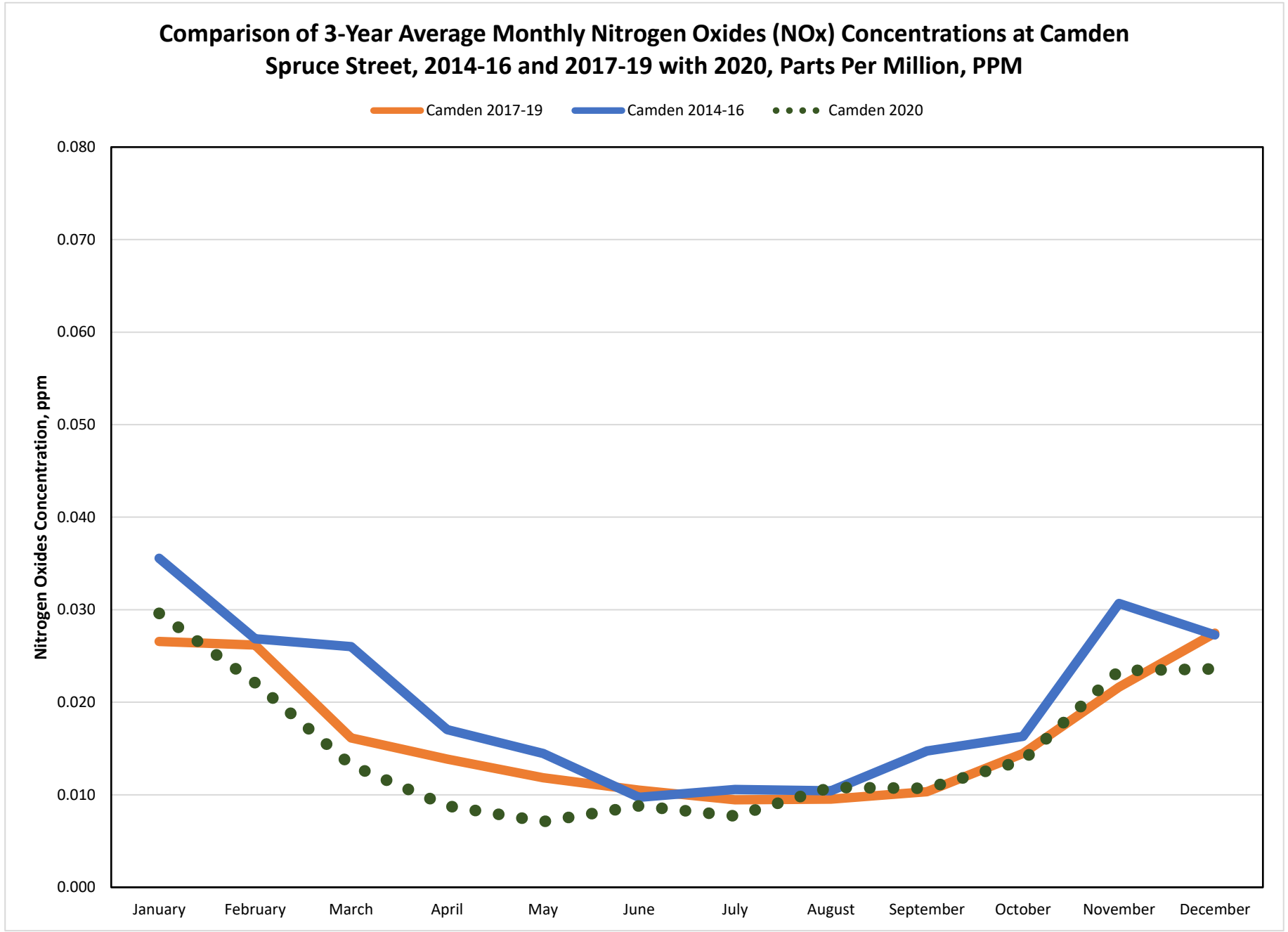
Satellite Images and Ground-Level Data

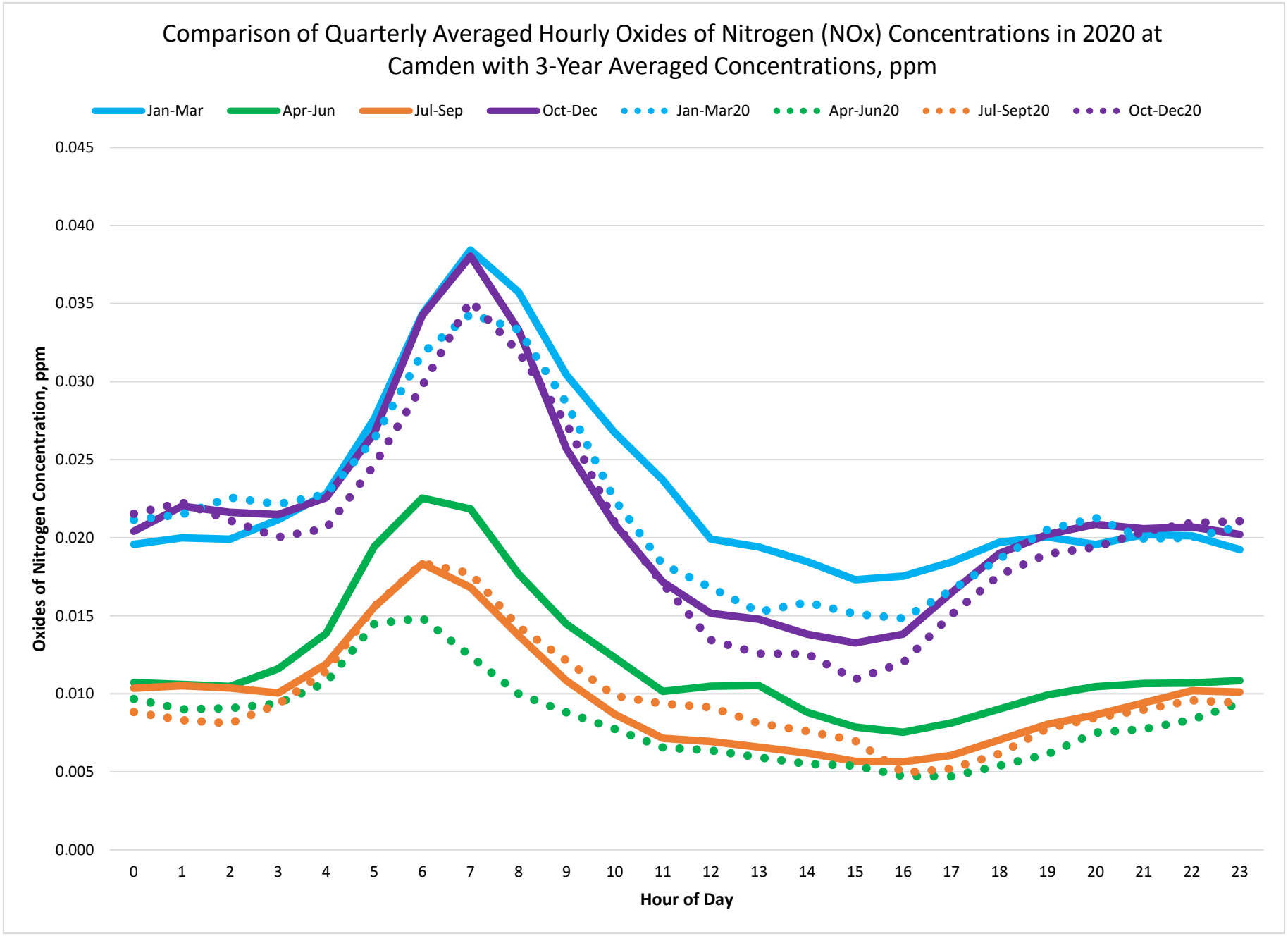
- Differences between satellite data and ground-level data:
  - Satellites detect NO_2 once it has reached steady state with NO and O_3 at an elevation from the height of the satellite to 50 meters above ground level
  - Ground-level NO and NO_2 data is highly variable due to rapid reactions with ground-level O_3 and other VOCs
  - For ground-level data, March and April are generally among the cleanest months of the year due to seasonal meteorology
- Monitors show steady declines since 2001 which contradicts reports that this is cleanest air since 9/11

Multi-Year Analysis of NOx

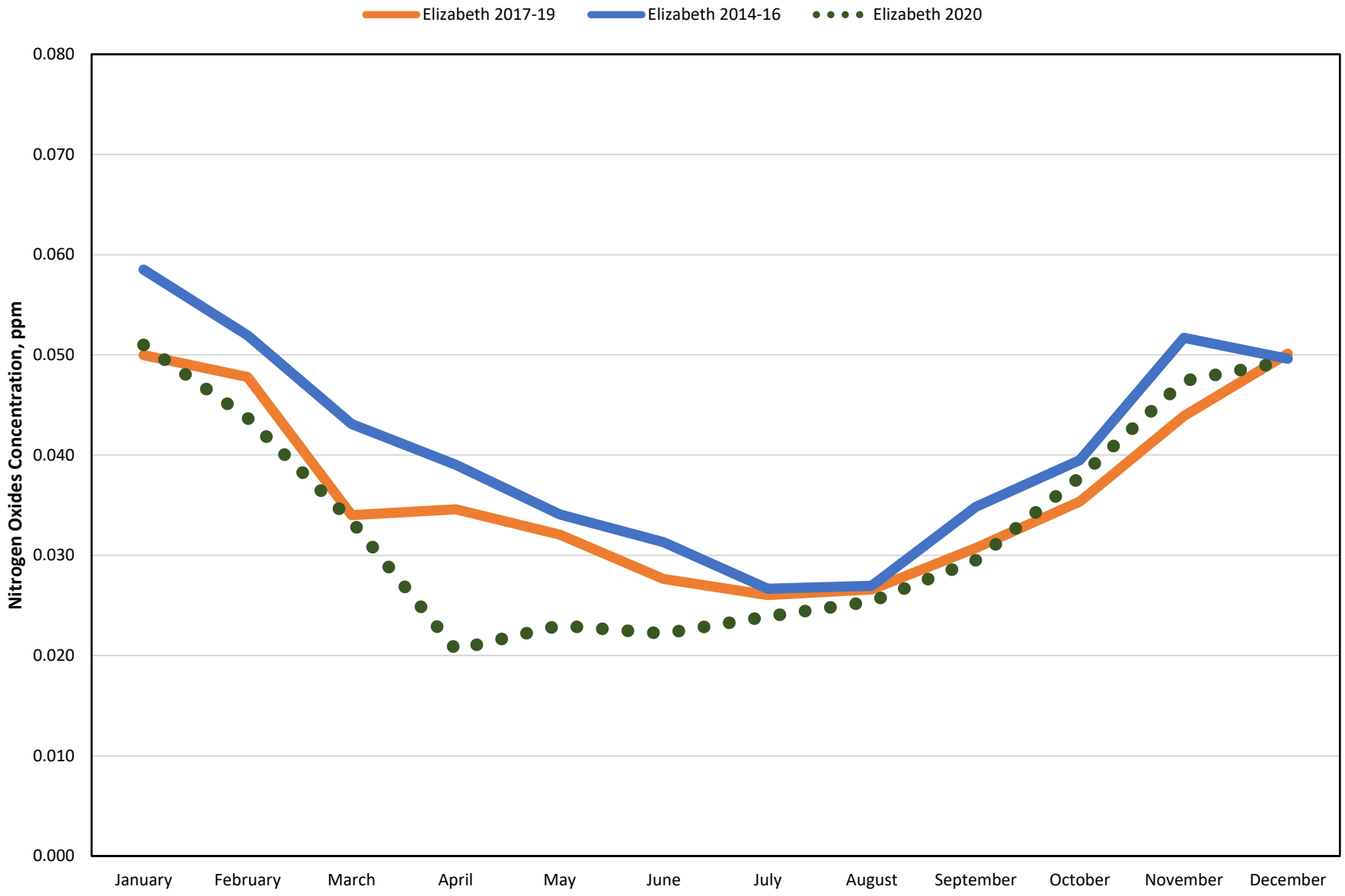
- Reduce effect of high and low concentration years by averaging 3-year periods, 2014-2016 and 2017-2019
- Use monthly averages for NOx
- Look at monthly average by hour of day
- Focus on urban air monitoring stations
  - Camden Spruce Street
  - Elizabeth Lab (NJ Turnpike Exit 13)
  - Jersey City

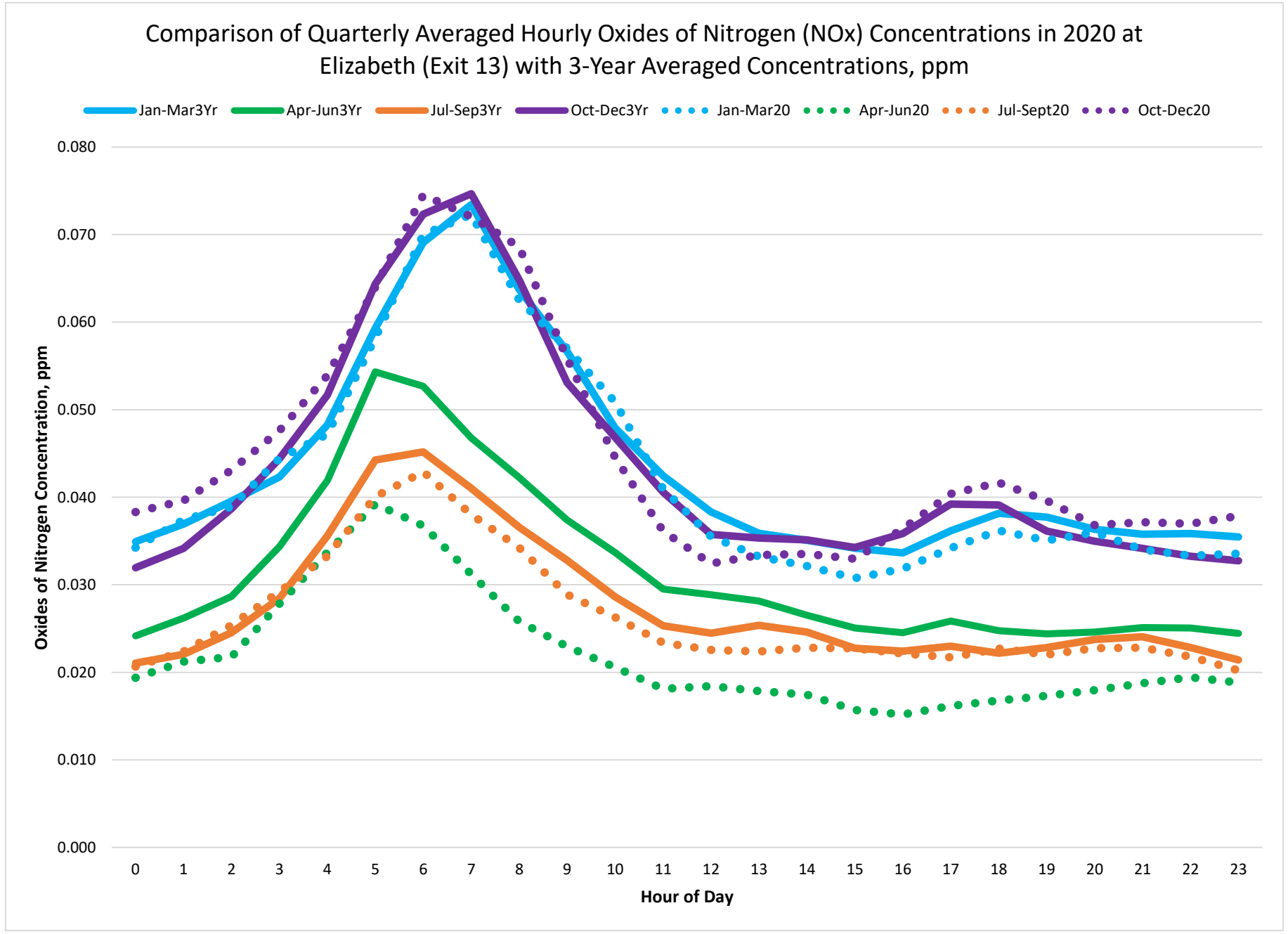
April and May 2020 data show significant decrease in NOx levels at all stations compared with historical data.

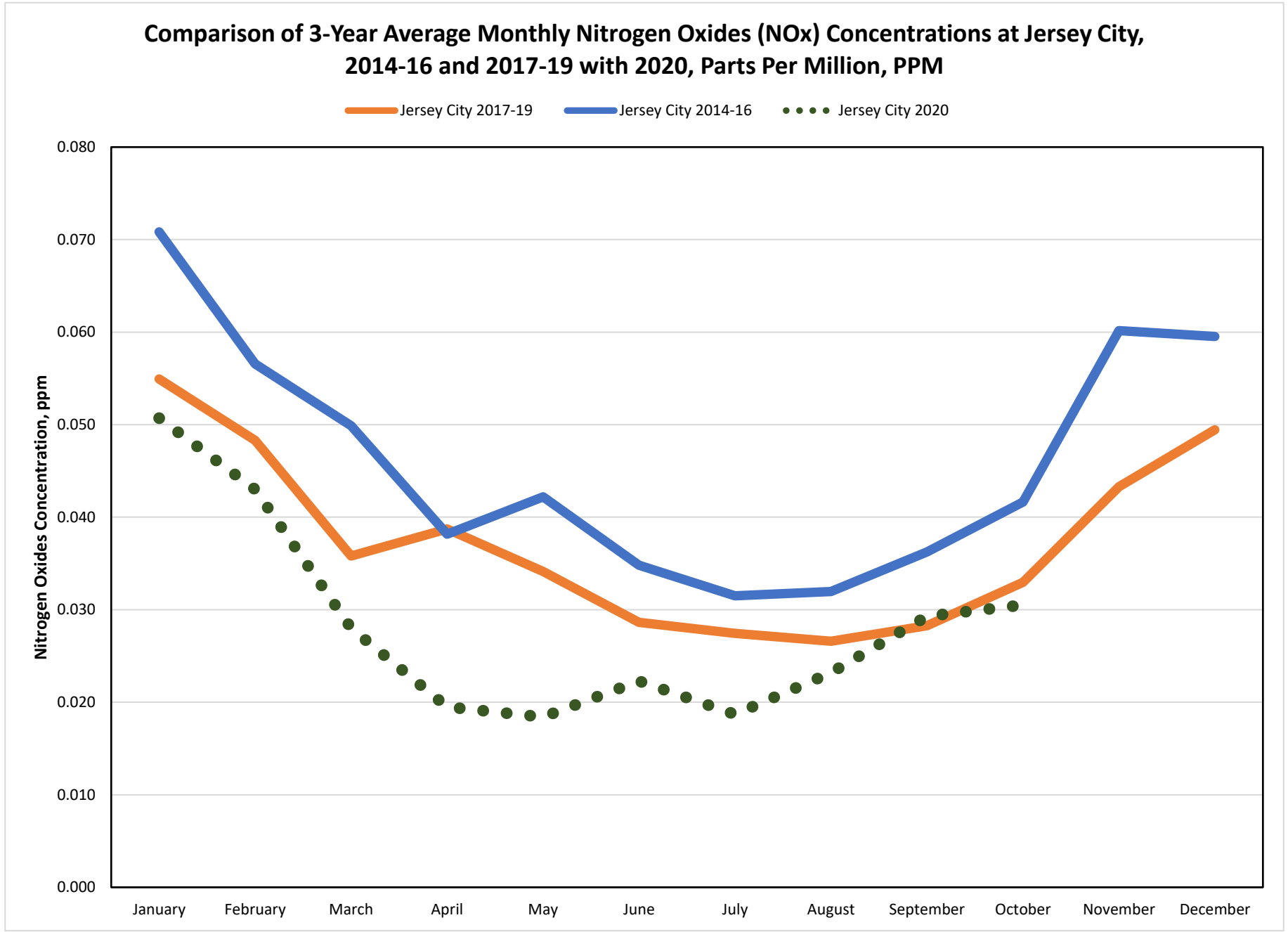

Comparison of 3-Year Average Monthly Nitrogen Oxides (NOx) Concentrations at Camden Spruce Street, 2014-16 and 2017-19 with 2020, Parts Per Million, PPM
Camden 2017-19
Camden 2014-16
Camden 2020
Nitrogen Oxides Concentration, ppm
0.080
0.070
0.060
0.050
0.040
0.030
0.020
0.010
0.000
January
February
March
April
May
June
July
August
September
October
November
December

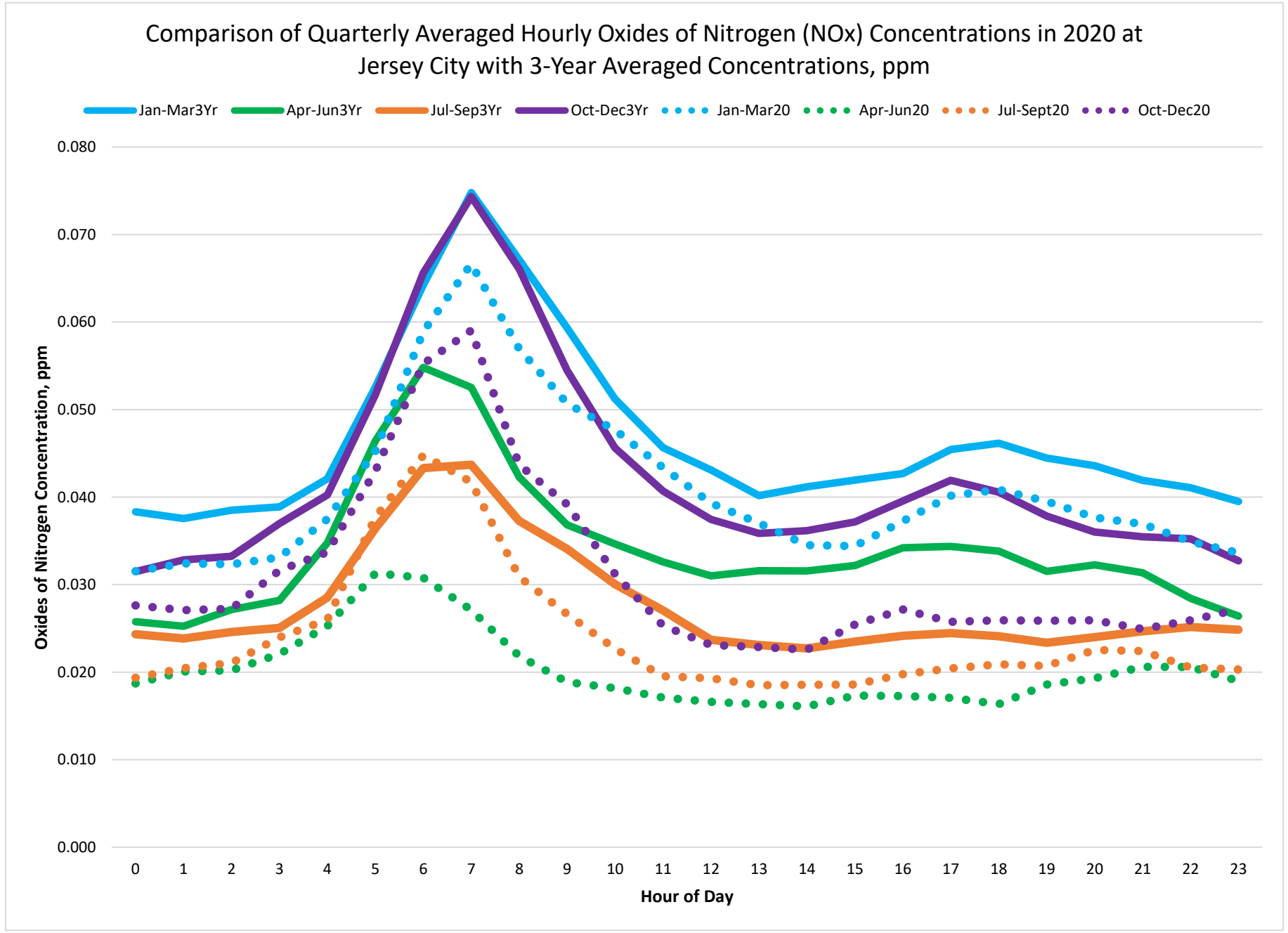

Comparison of Quarterly Averaged Hourly Oxides of Nitrogen (NOx) Concentrations in 2020 at Camden with 3-Year Averaged Concentrations, ppm
Jan-Mar
Apr-Jun
Jul-Sep
Oct-Dec
Jan-Mar20
Apr-Jun20
Jul-Sept20
Oct-Dec20
Oxides of Nitrogen Concentration, ppm
0.045
0.040
0.035
0.030
0.025
0.020
0.015
0.010
0.005
0.000
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23
Hour of Day

Comparison of 3-Year Average Monthly Nitrogen Oxides (NOx) Concentrations at Elizabeth, Exit 13, 2014-16 and 2017-19 with 2020, Parts Per Million, PPM




Comparison of Quarterly Averaged Hourly Oxides of Nitrogen (NOx) Concentrations in 2020 at Elizabeth (Exit 13) with 3-Year Averaged Concentrations, ppm
Jan-Mar3Yr
Apr-Jun3Yr
Jul-Sep3Yr
Oct-Dec3Yr
Jan-Mar20
Apr-Jun20
Jul-Sept20
Oct-Dec20
Oxides of Nitrogen Concentration, ppm
0.080
0.070
0.060
0.050
0.040
0.030
0.020
0.010
0.000
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23
Hour of Day


Comparison of 3-Year Average Monthly Nitrogen Oxides (NOx) Concentrations at Jersey City, 2014-16 and 2017-19 with 2020, Parts Per Million, PPM
Jersey City 2017-19
Jersey City 2014-16
Jersey City 2020
Nitrogen Oxides Concentration, ppm
0.080
0.070
0.060
0.050
0.040
0.030
0.020
0.010
0.000
January
February
March
April
May
June
July
August
September
October
November
December

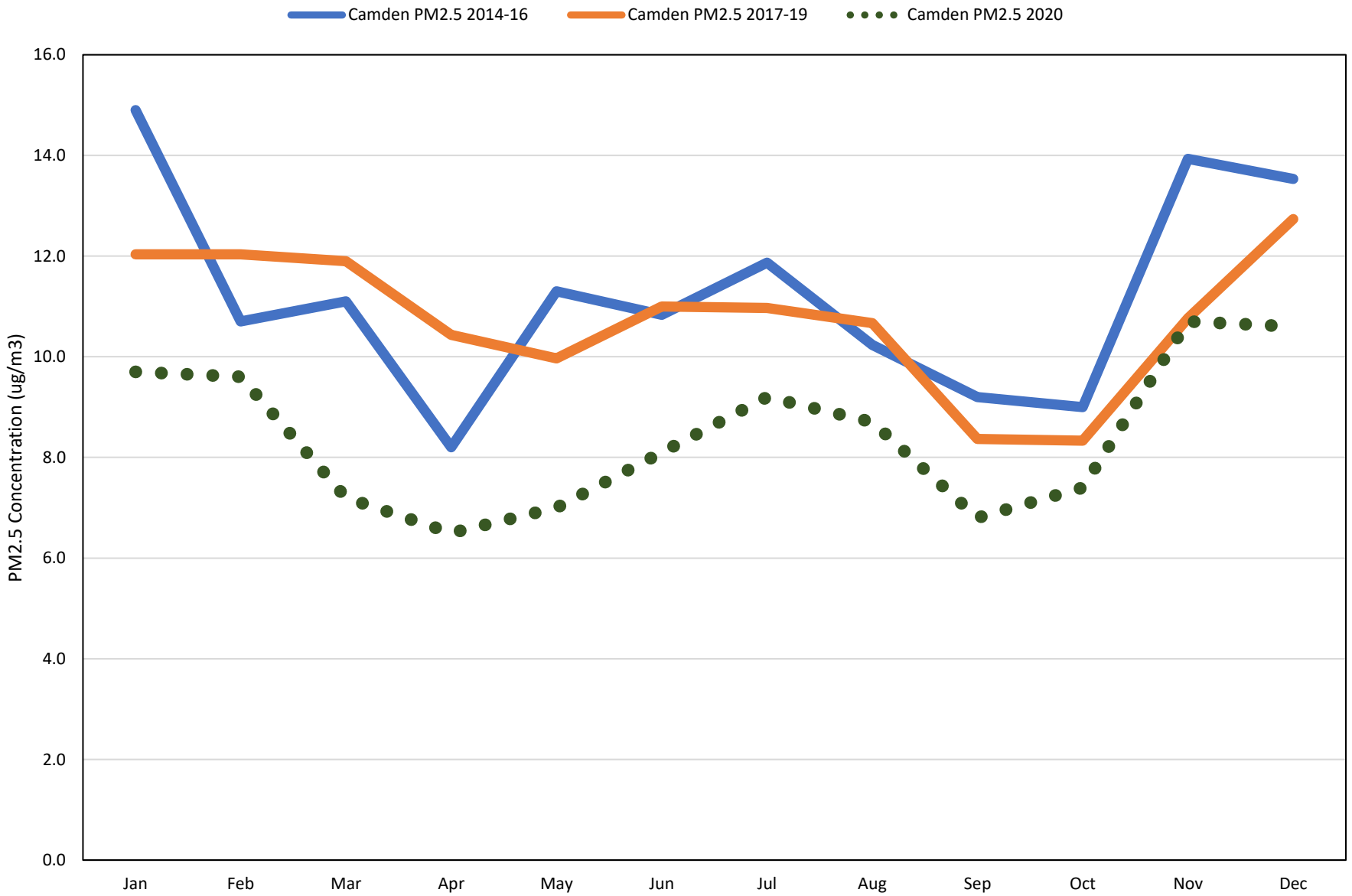

Comparison of Quarterly Averaged Hourly Oxides of Nitrogen (NOx) Concentrations in 2020 at Jersey City with 3-Year Averaged Concentrations, ppm
Jan-Mar3Yr
Apr-Jun3Yr
Jul-Sep3Yr
Oct-Dec3Yr
Jan-Mar20
Apr-Jun20
Jul-Sept20
Oct-Dec20
Oxides of Nitrogen Concentration, ppm
0.080
0.070
0.060
0.050
0.040
0.030
0.020
0.010
0.000
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23
Hour of Day

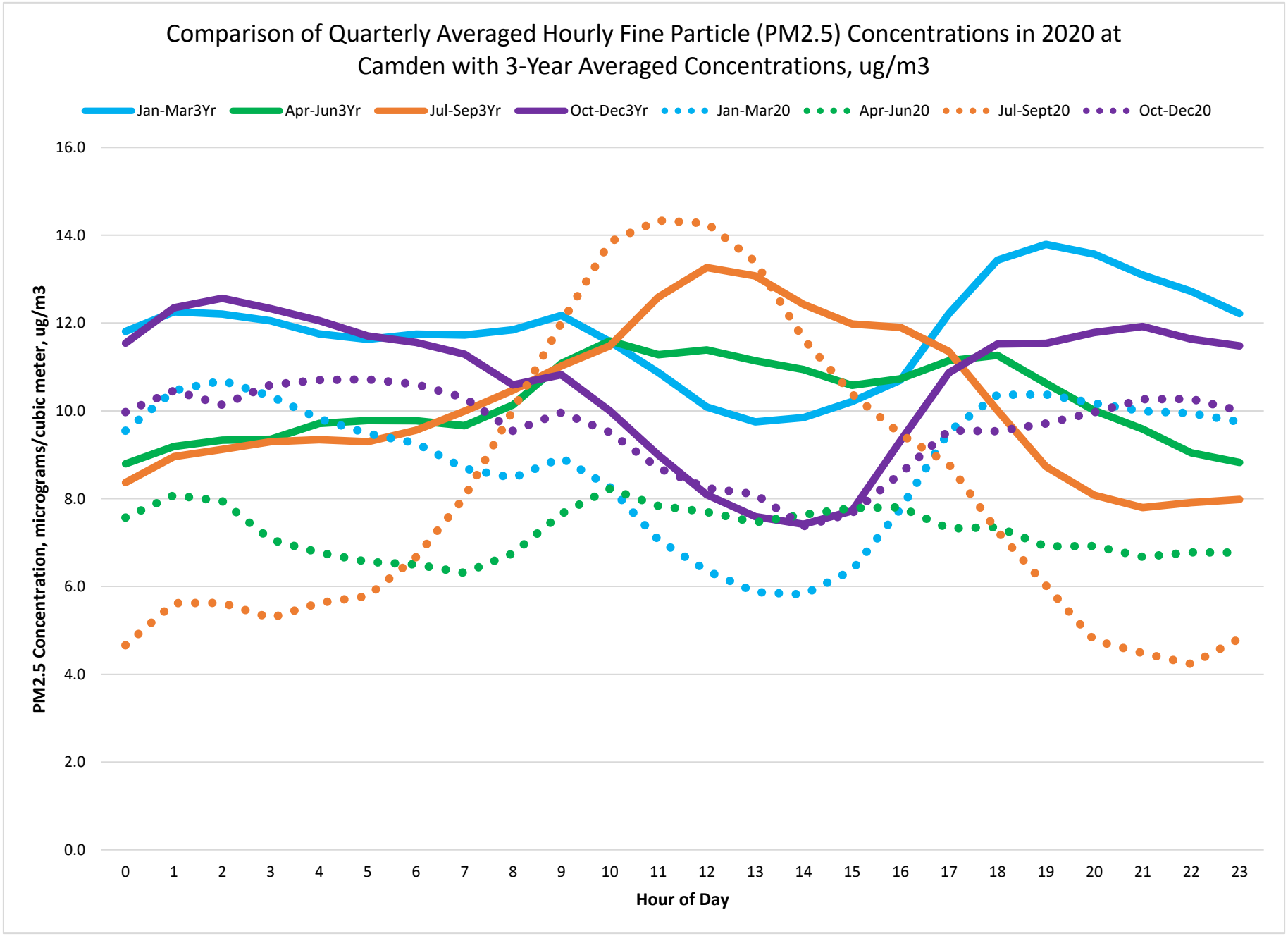
Multi-Year Analysis of $PM_{2.5}$

- Reduce effect of high and low concentration years by averaging 3-year periods, 2014-2016 and 2017-2019
- Use monthly averages for $PM_{2.5}$
- Look at monthly average by hour of day
- Focus on urban air monitoring stations
  - Camden Spruce Street
  - Elizabeth Lab (NJ Turnpike Exit 13)
  - Jersey City

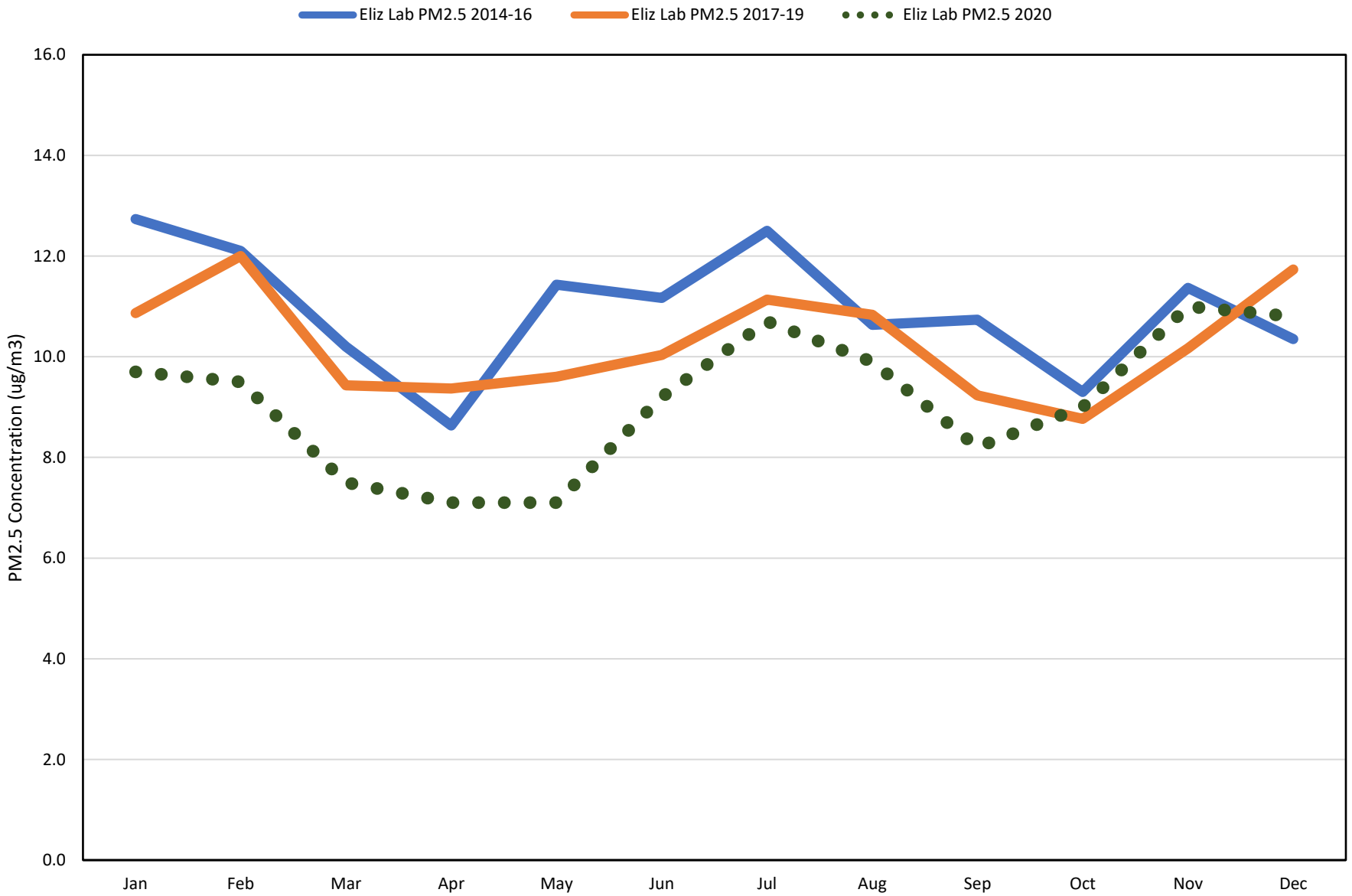
April and May 2020 data show significant decrease in $PM_{2.5}$ levels at all stations compared with historical data.

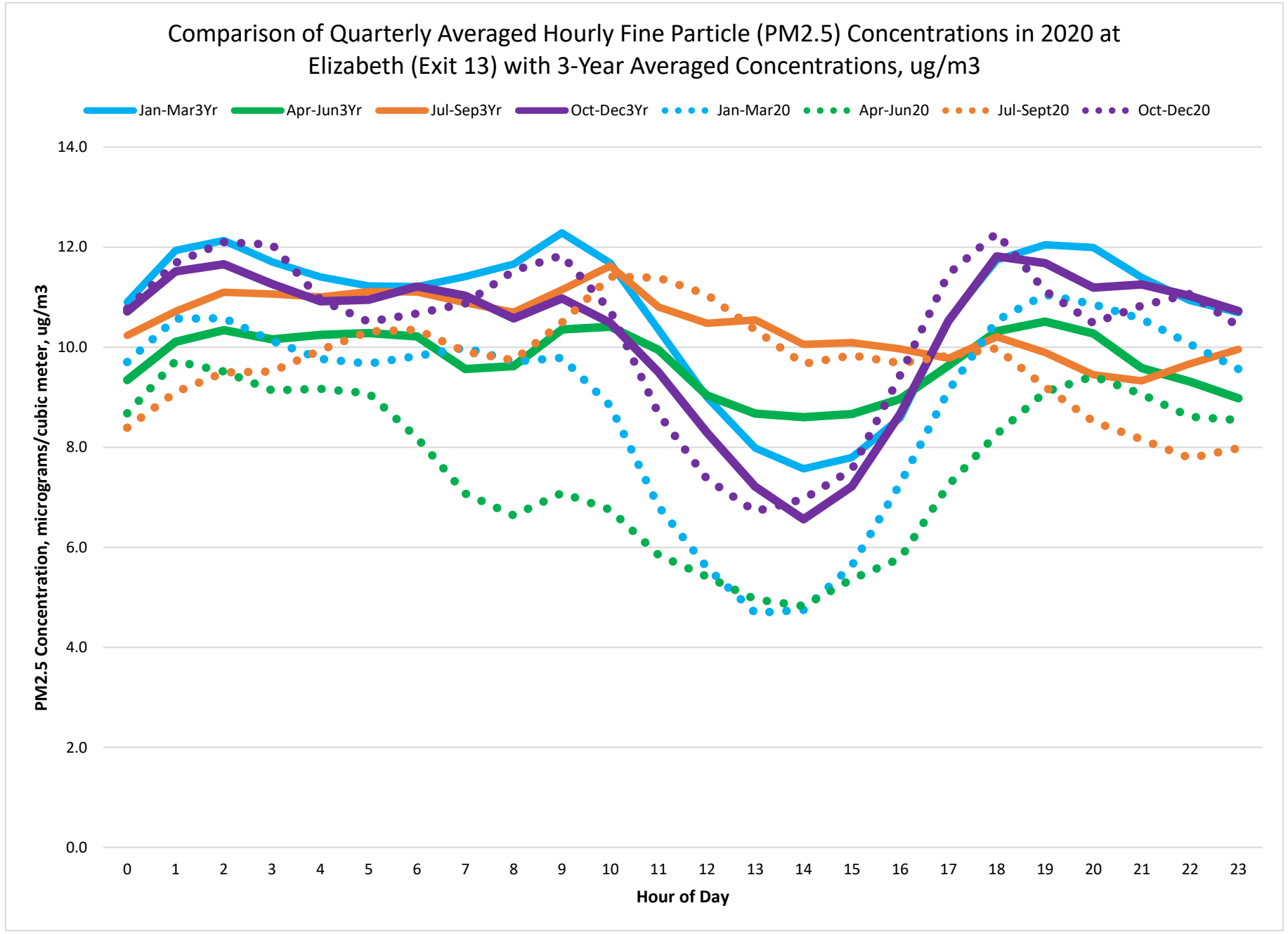
Comparison of 3-Year Average Monthly Fine Particle (PM2.5) Concentrations at Camden, 2014-16, and 2017-19 with 2020, Micrograms per Cubic Meter, ug/m3



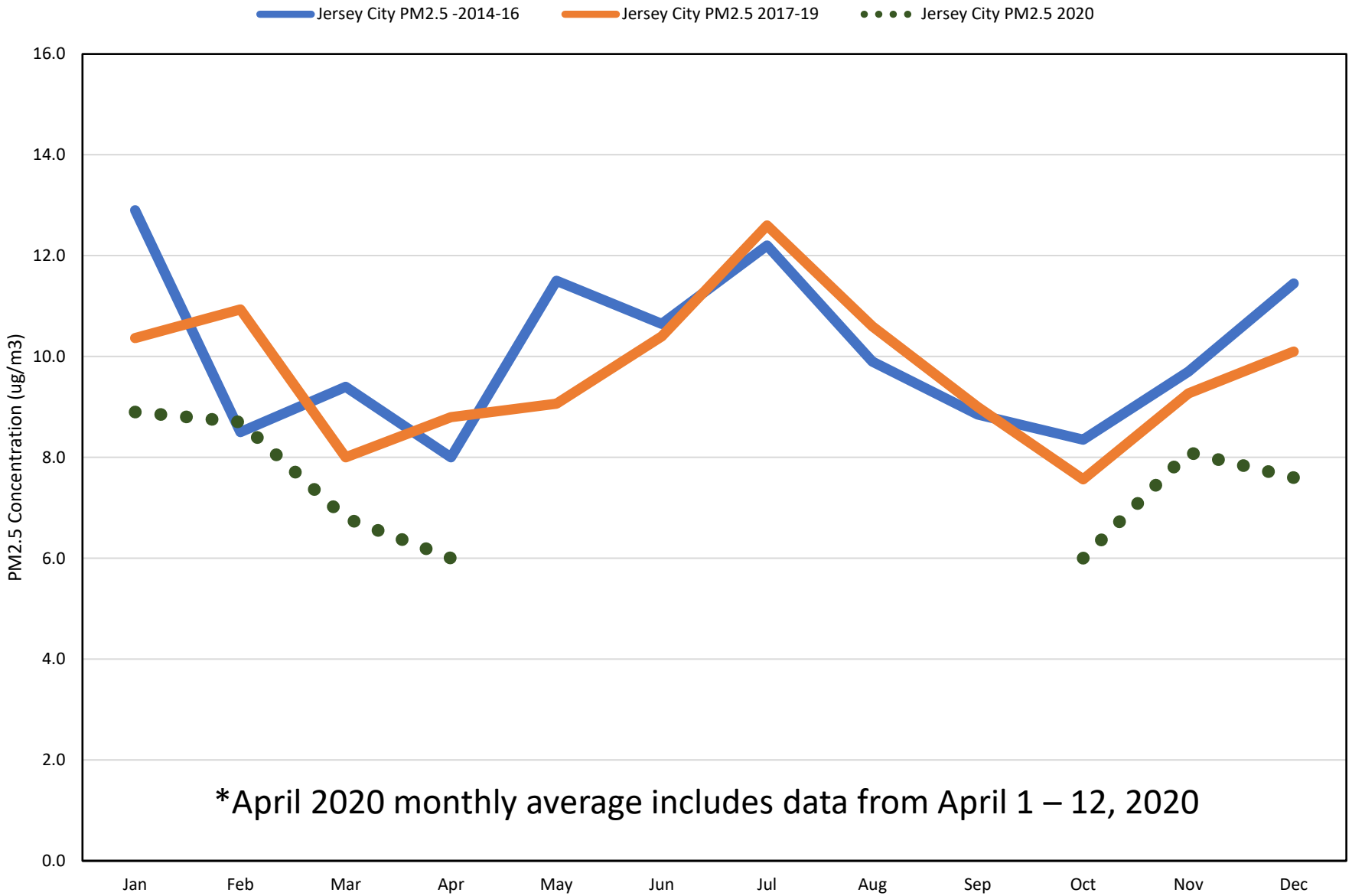

Comparison of Quarterly Averaged Hourly Fine Particle (PM2.5) Concentrations in 2020 at Camden with 3-Year Averaged Concentrations, ug/m3
Jan-Mar3Yr
Apr-Jun3Yr
Jul-Sep3Yr
Oct-Dec3Yr
Jan-Mar20
Apr-Jun20
Jul-Sept20
Oct-Dec20
PM2.5 Concentration, micrograms/cubic meter, ug/m3
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23
Hour of Day

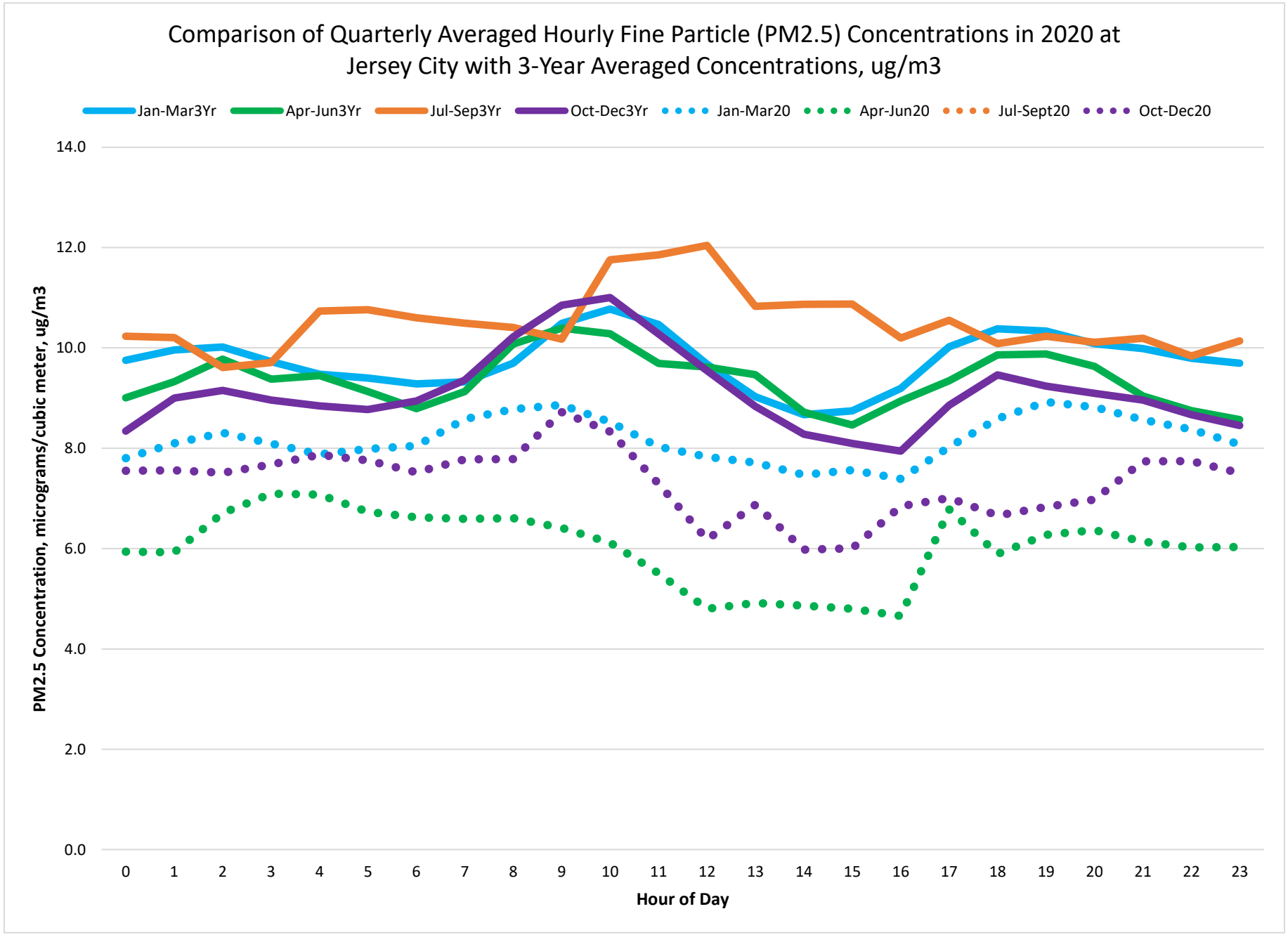
Comparison of 3-Year Average Monthly Fine Particle (PM2.5) Concentrations at Elizabeth Lab Exit 13, 2014-16 and 2017-19 with 2020, Micrograms per Cubic Meter, ug/m3




Comparison of Quarterly Averaged Hourly Fine Particle (PM2.5) Concentrations in 2020 at Elizabeth (Exit 13) with 3-Year Averaged Concentrations, ug/m3
Jan-Mar3Yr
Apr-Jun3Yr
Jul-Sep3Yr
Oct-Dec3Yr
Jan-Mar20
Apr-Jun20
Jul-Sept20
Oct-Dec20
PM2.5 Concentration, micrograms/cubic meter, ug/m3
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23
Hour of Day

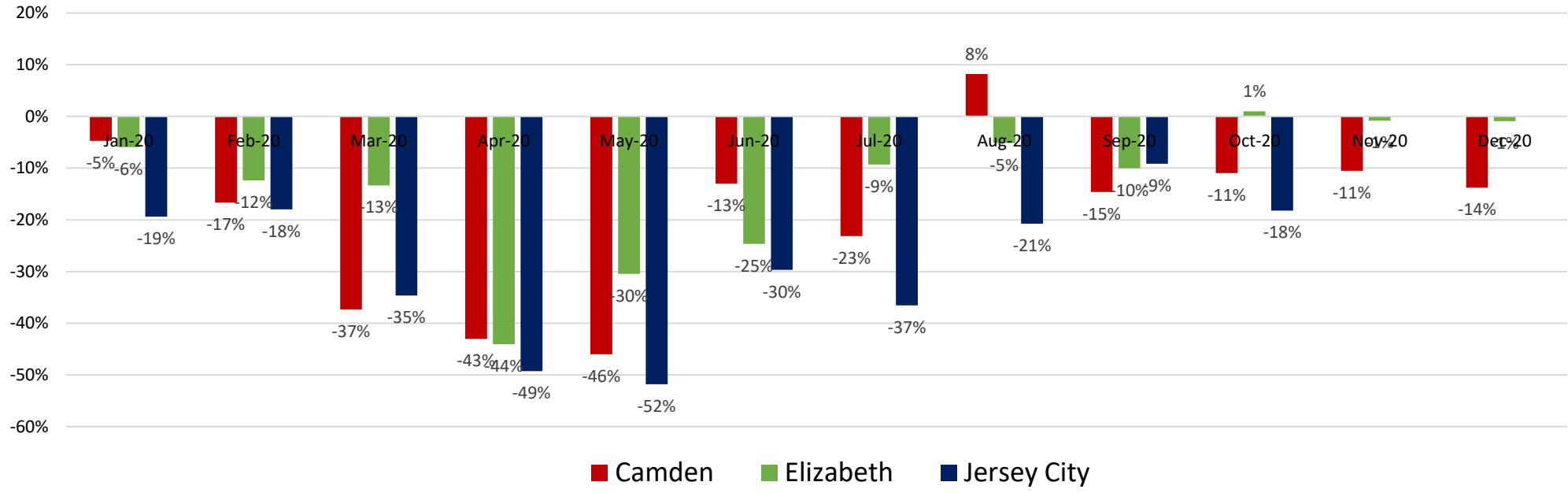
Comparison of 3-Year Average Monthly Fine Particle (PM2.5) Concentrations at Jersey City, 2014-16 and 2017-19 with 2020, Micrograms per Cubic Meter, ug/m3




Comparison of Quarterly Averaged Hourly Fine Particle (PM2.5) Concentrations in 2020 at Jersey City with 3-Year Averaged Concentrations, ug/m3
Jan-Mar3Yr
Apr-Jun3Yr
Jul-Sep3Yr
Oct-Dec3Yr
Jan-Mar20
Apr-Jun20
Jul-Sept20
Oct-Dec20
PM2.5 Concentration, micrograms/cubic meter, ug/m3
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23
Hour of Day

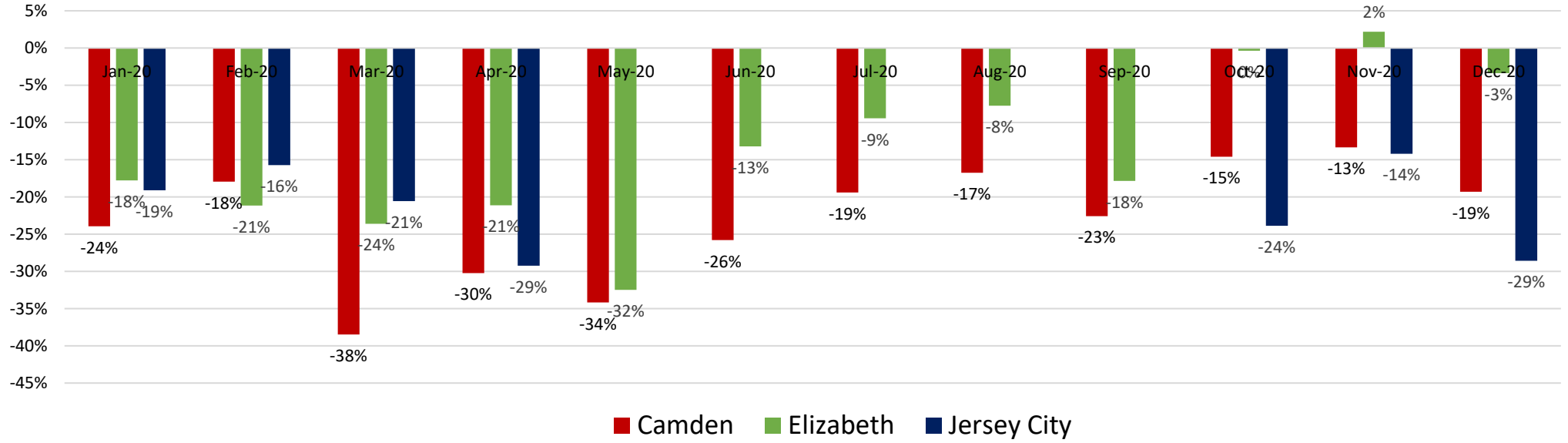
Summary of NOx Concentrations

- Percent Change in 2014-2019 Monthly Average NOx Concentrations versus 2020 NOx Concentrations



Summary of $PM_{2.5}$ Concentrations

- Percent Change in 2014-2019 Monthly Average $PM_{2.5}$ Concentrations versus 2020 $PM_{2.5}$ Concentrations*



*April 2020 monthly average at Jersey City includes data from April 1 – 12, 2020

End

www.nj.gov/dep/airmon

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References

- (a) https://www.tirebusiness.com/coronavirus/vehicle-miles-traveled-dropped-38-end-march
- (b)https://www.greentechmedia.com/articles/read/how-new-yorks-coronavirus-lockdown-is-driving-down-power-demand
- (c) https://www.utilitydive.com/news/utilities-are-beginning-to-see-the-load-impacts-of-covid-19-as-economic-sh/574632/