

Characterizing nitrogen oxides and fine PM near major highways in the U.S. using the national near-road monitoring network

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National Ambient Air Monitoring Conference

August 25th, 2022

Near-Road Network

- Established as part of the 2010 Nitrogen Dioxide (NO₂) National Ambient Air Quality Standards (NAAQS)
- Located within 50m of a target road at locations where peak hourly NO₂ concentrations are expected
- NO₂ monitor required to be installed in Core Based Statistical Areas (CBSAs) with a population ≥ 1 million by January 1st, 2014, with a second site required for CBSAs with a population of ≥ 2.5 million by January 1st, 2015
- PM_{2.5} and CO monitors required to be co-located with established near-road NO₂ monitors by January 1st, 2015 or January 1st, 2017
- Fun Fact: I've pointed out near-road sites to my wife every time we've driven by one

Parkway East Near-Road site in Wilkinsburg, PA



Characterizing Nitrogen Oxides and Fine Particulate Matter near Major Highways in the United States Using the National Near-Road Monitoring Network

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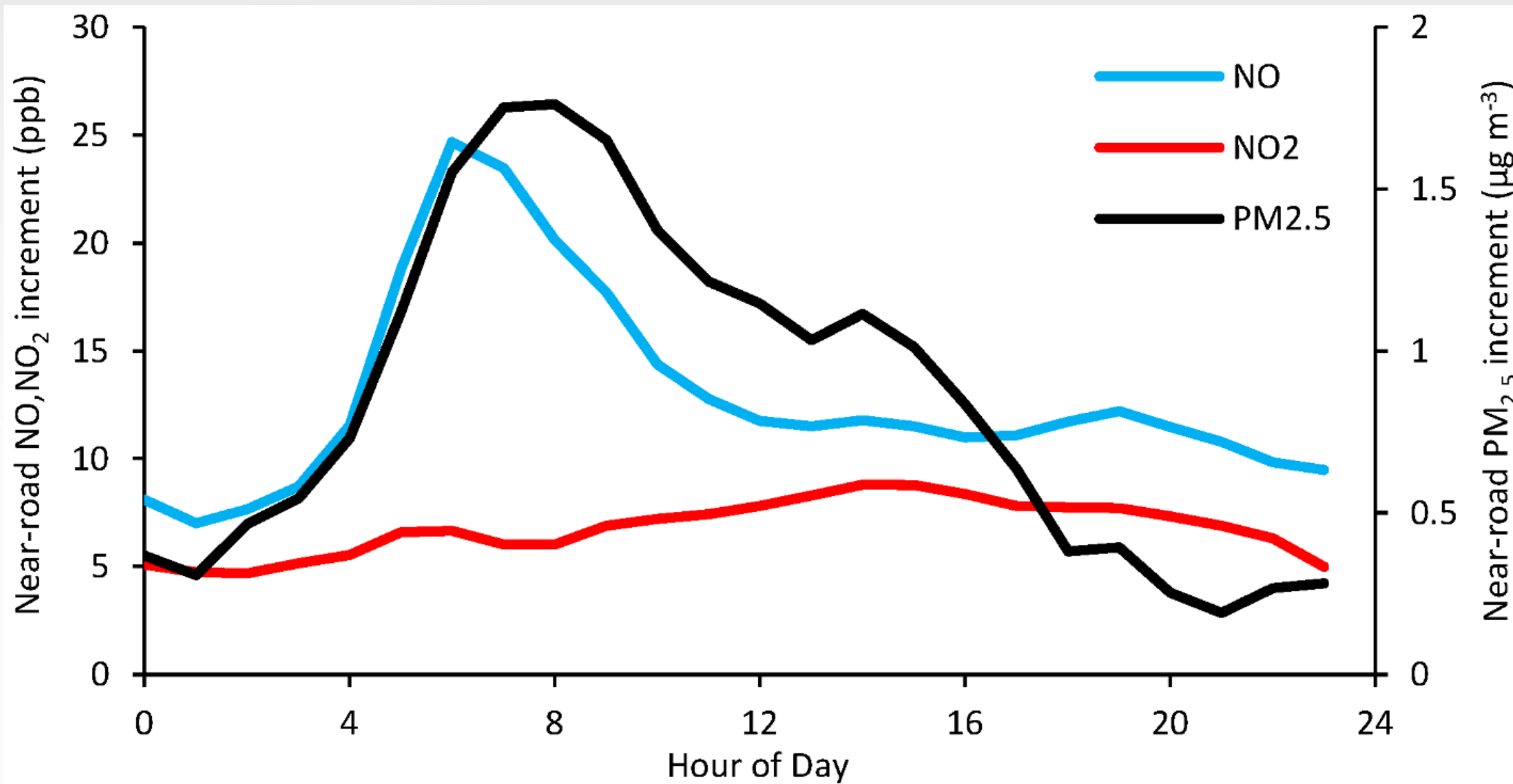


Cite This: *Environ. Sci. Technol.* 2021, 55, 2831–2838

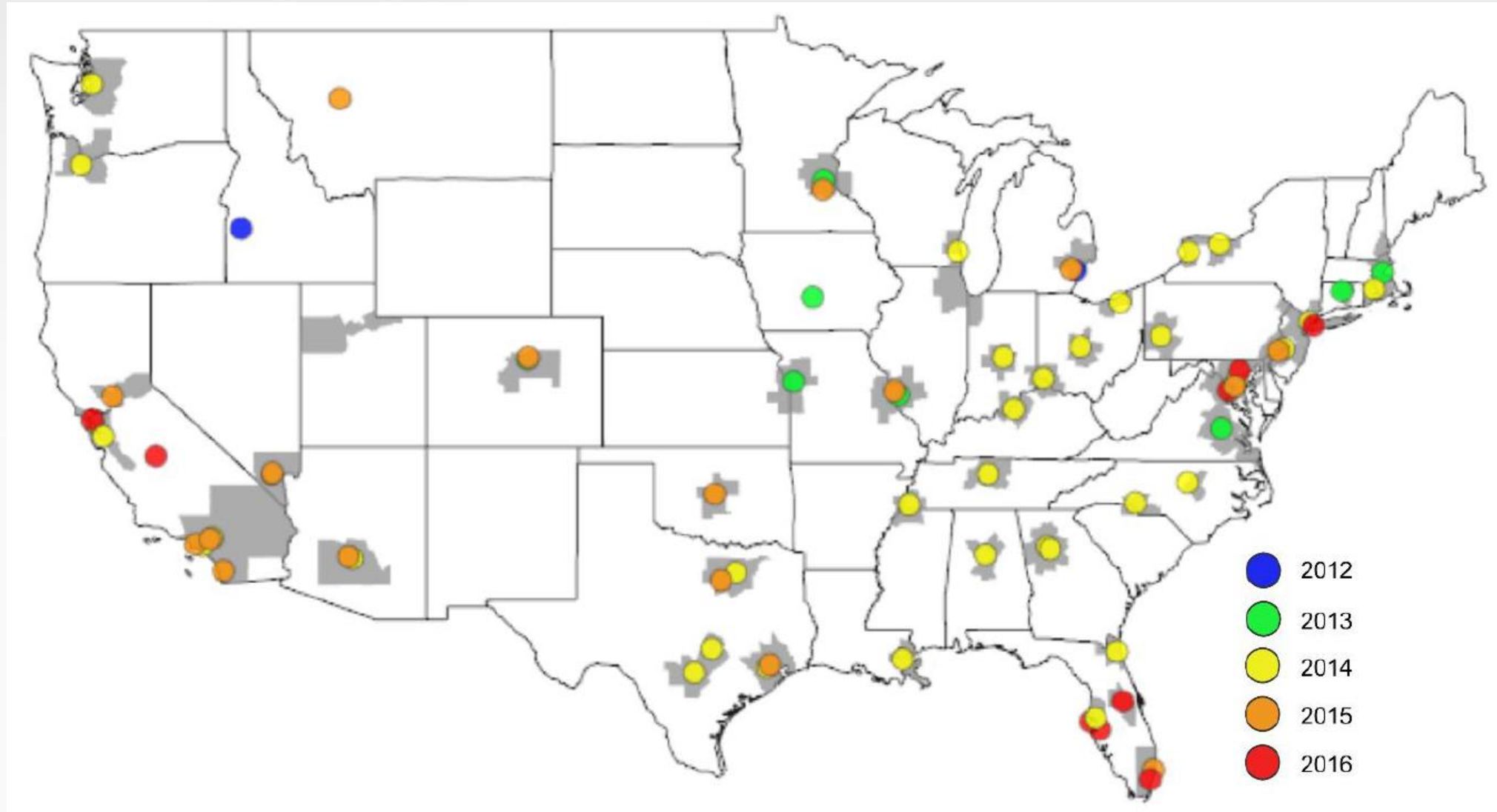


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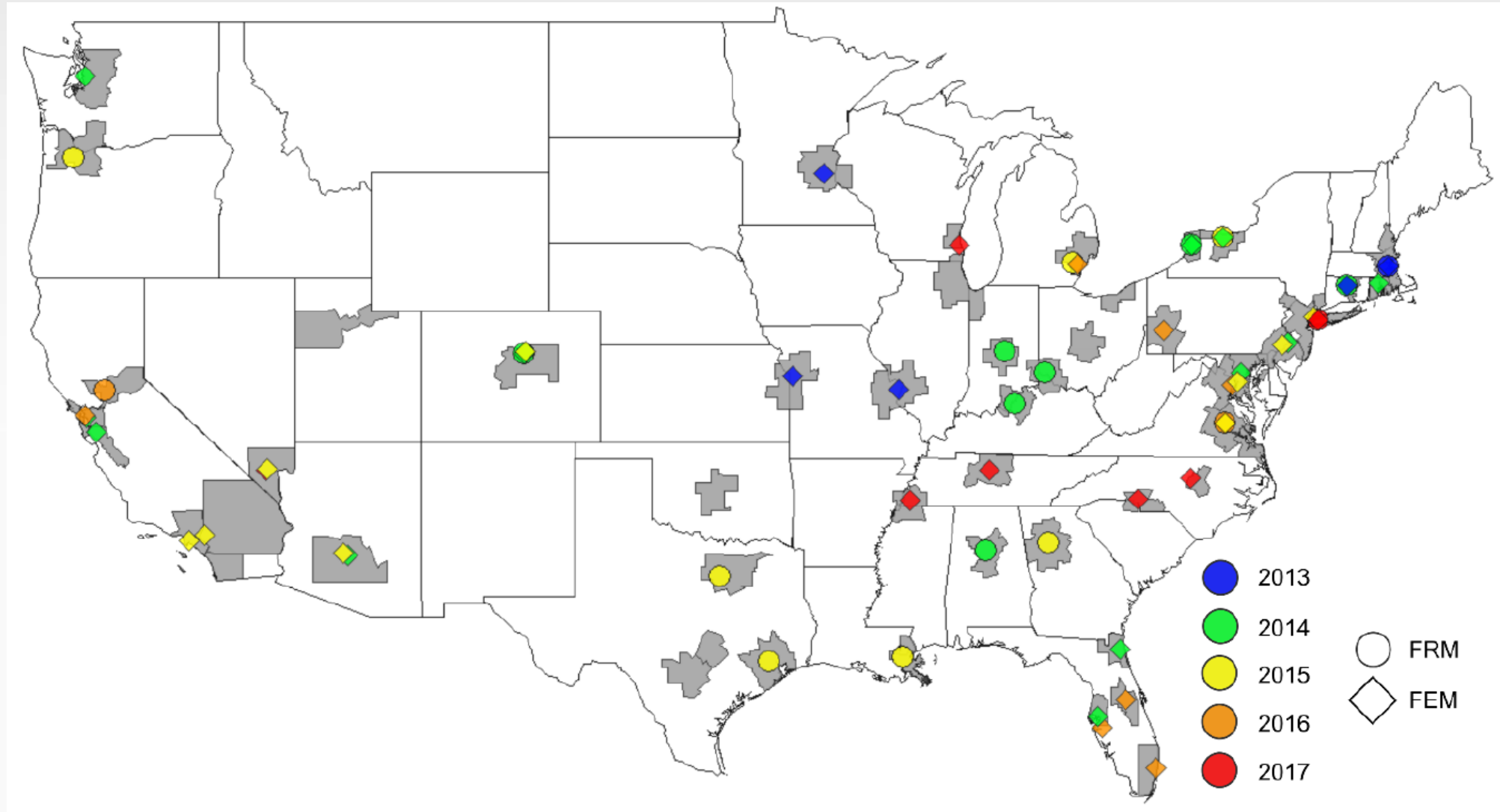
NO, NO₂, and PM_{2.5} Hourly Increment



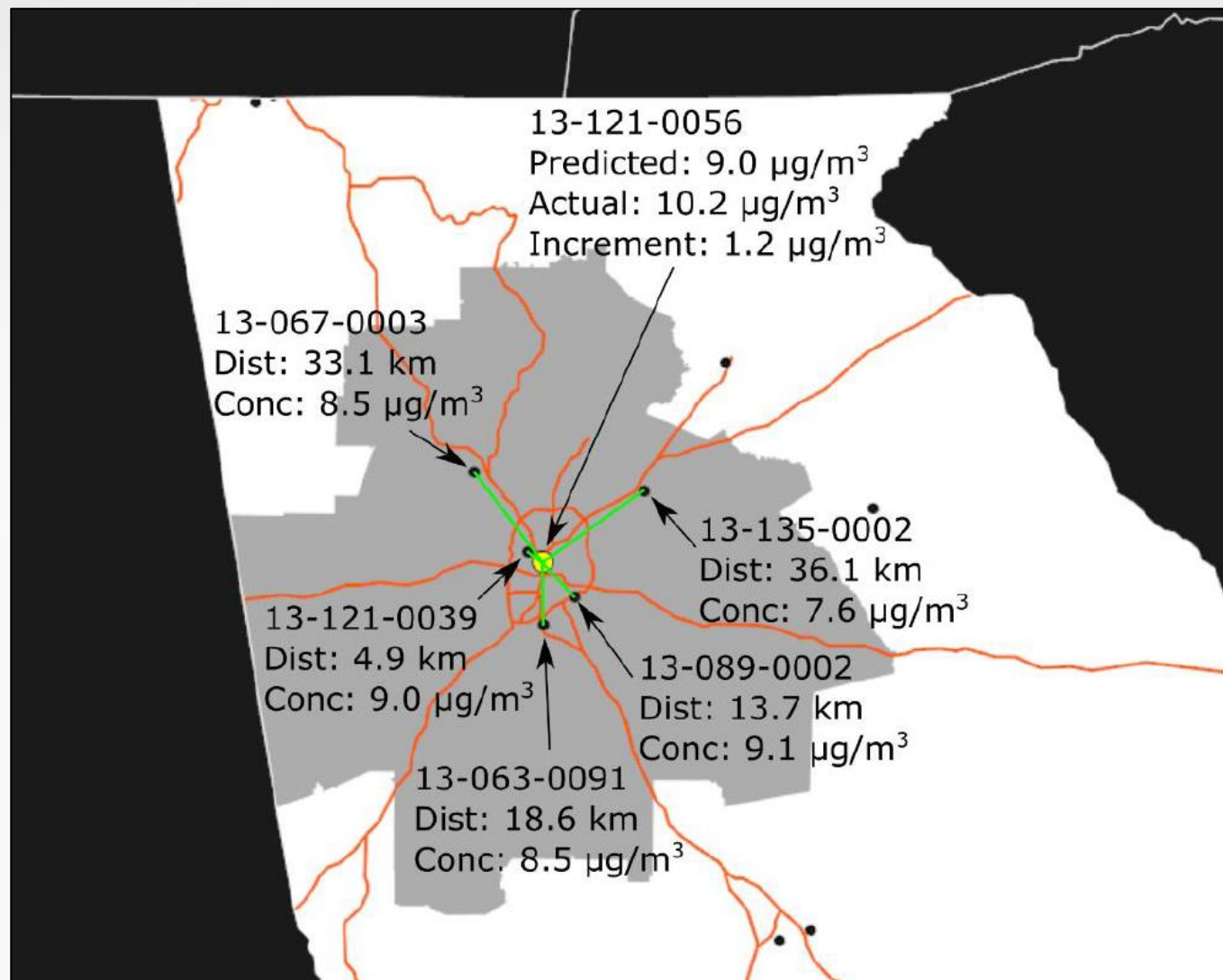
NO₂ Near-Road Monitor Deployment



PM_{2.5} Near-Road Monitor Deployment



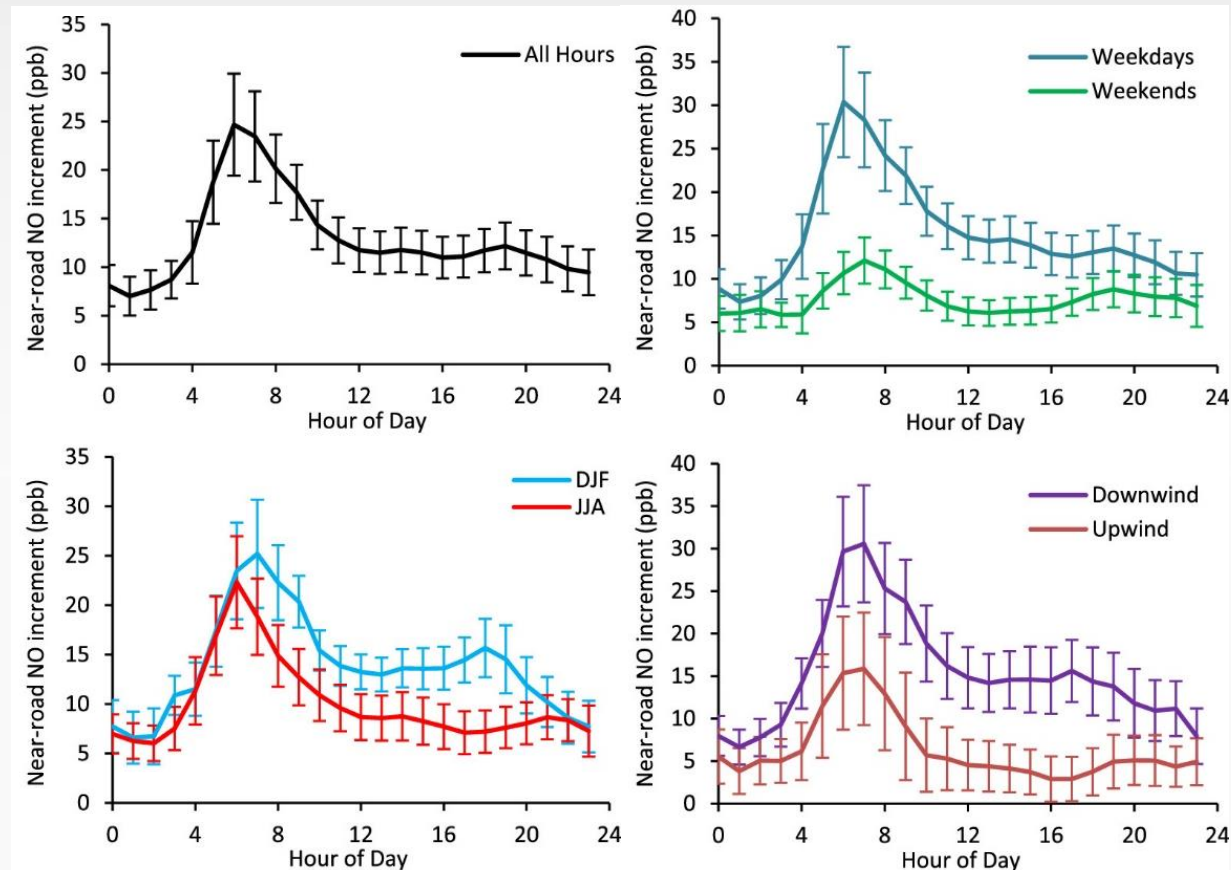
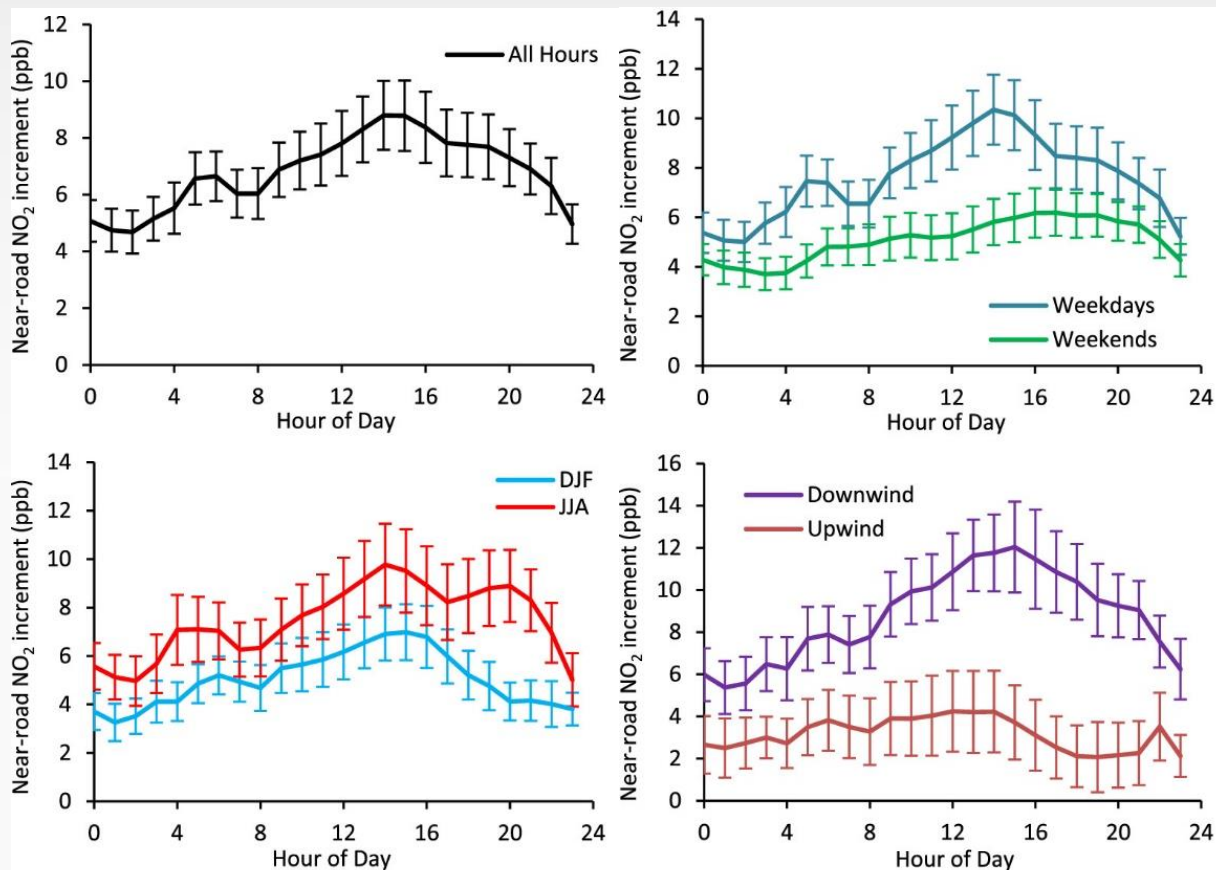
Calculating the Near-Road Increment



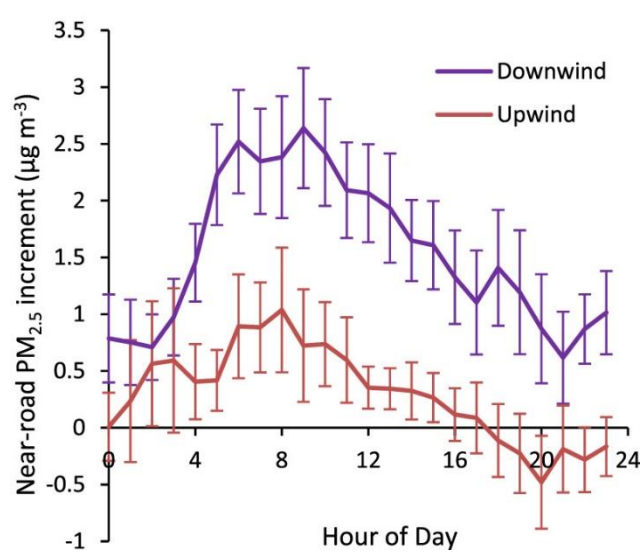
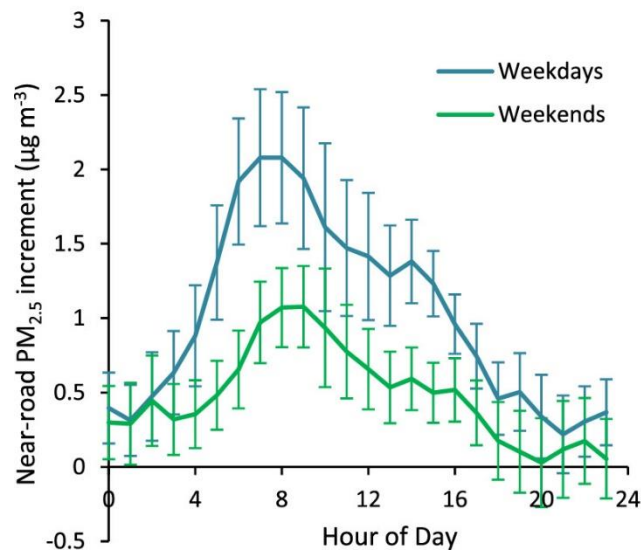
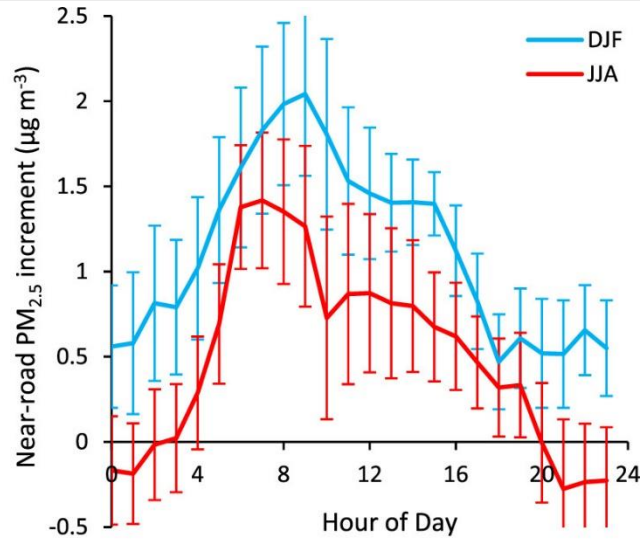
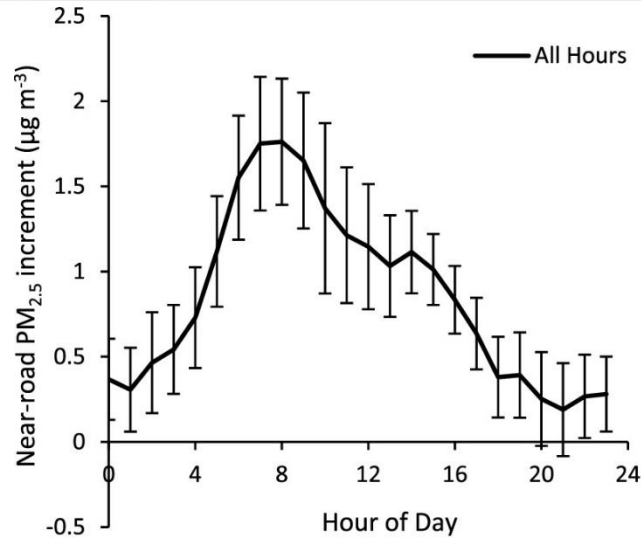
Hourly NO₂ and NO Near-Road Increment

NO₂

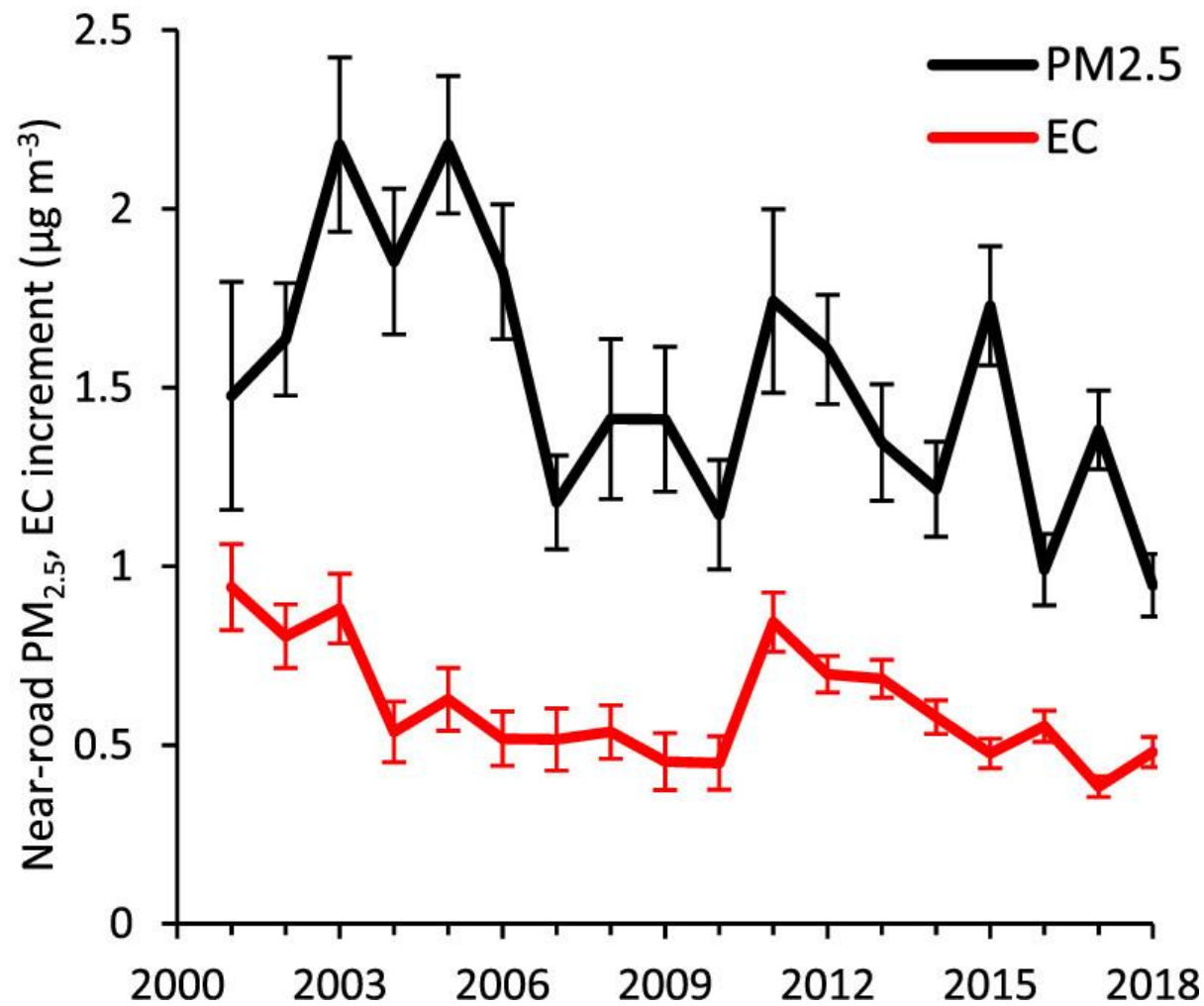
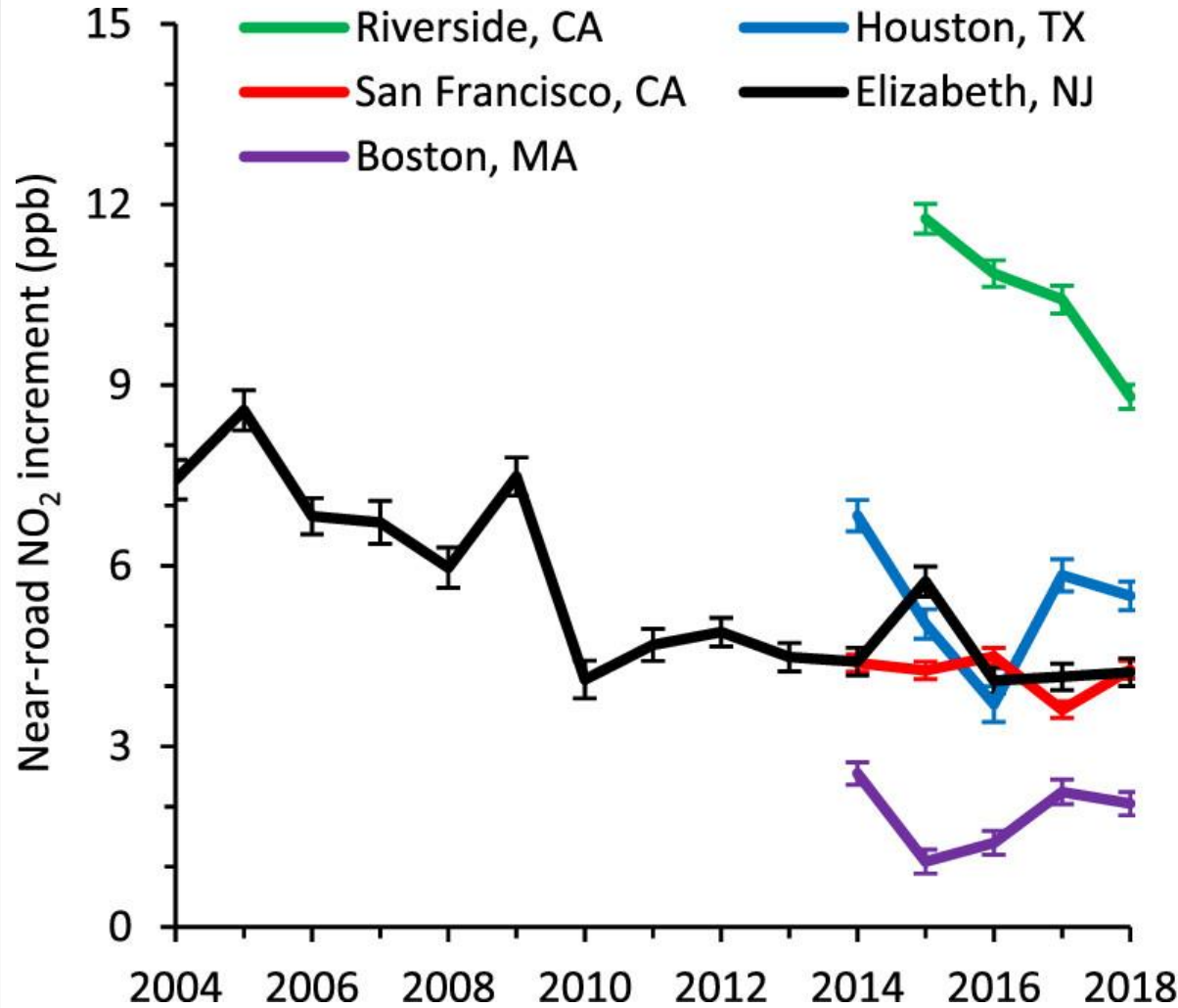
NO



Hourly PM_{2.5} Near-Road Increment



Near-Road Increment Changes Over Time



Near-Road Impact on 2016-2018 Design Values

CBSA NAME (largest city listed)	Max near-road NO ₂ annual design value	Max near-road NO ₂ 1-hour design value	Max near-road PM _{2.5} annual design value	Max near-road PM _{2.5} daily design value
Atlanta, GA	16 (8)	53 (45)	10.1 (9.4)	21 (21)
Austin, TX	12 (5)	47 (30)	NA (9.8)	NA (22)
Baltimore, MD	16 (13)	47 (50)	9.1 (8.4)	19 (20)
Birmingham, AL	11 (8)	NA	10.5 (10)	22 (21)
Boston, MA	13 (13)	45 (48)	7.7 (7.0)	17 (17)
Buffalo, NY	10 (10)	42 (47)	7.2 (7.2)	16 (17)
Charlotte, NC	10 (6)	38 (38)	8.8 (8.5)	18 (18)
Cincinnati, OH	19 (10)	53 (40)	NA (10.5)	NA (23)
Cleveland, OH	8 (11)	39 (48)	NA (11.0)	NA (23)
Columbus, OH	10 (10)	41 (NA)	NA (8.4)	NA (19)
Dallas, TX	11 (9)	43 (45)	8.6 (8.9)	18 (20)
Denver, CO	27 (19)	70 (69)	9.2 (7.1)	24 (25)
Detroit, MI	16 (10)	44 (42)	8.3 (11.3)	23 (28)
Fresno, CA	21 (14)	57 (51)	NA (15.0)	NA (60)
Hartford, CT	13 (8)	50 (43)	7.5 (6.5)	18 (18)
Houston, TX	12 (10)	49 (49)	9.9 (10.2)	23 (25)
Indianapolis, IN	14 (8)	41 (42)	10.4 (10.0)	25 (23)
Jacksonville, FL	11 (7)	NA	NA	NA
Kansas City, MO	11 (12)	42 (47)	7.4 (9.1)	16 (25)
Las Vegas, NV	27 (18)	59 (54)	NA (9.5)	NA (24)
Los Angeles, CA	22 (19)	79 (67)	12.7 (12.6)	33 (38)
Louisville, KY	15 (9)	47 (39)	9.4 (9.1)	21 (22)
Memphis, TN	10 (7)	37 (38)	NA (8.4)	NA (17)
Miami, FL	15 (11)	NA (44)	NA (8.0)	NA (17)

CBSA NAME (largest city listed)	Max near-road NO ₂ annual design value	Max near-road NO ₂ 1-hour design value	Max near-road PM _{2.5} annual design value	Max near-road PM _{2.5} daily design value
Milwaukee, WI	14 (9)	46 (44)	NA (8.3)	NA (21)
Minneapolis, MN	13 (8)	42 (41)	7.4 (7.9)	19 (21)
Nashville, TN	14 (8)	51 (36)	NA (8.4)	NA (17)
New Orleans, LA	10 (6)	45 (38)	8.0 (8.3)	18 (19)
New York, NY	17 (19)	63 (60)	NA (9.5)	22 (23)
Oklahoma City, OK	13 (7)	45 (43)	NA (8.6)	NA (19)
Philadelphia, PA	11 (11)	44 (48)	9.2 (10.7)	22 (24)
Phoenix, AZ	28 (18)	64 (59)	8.2 (13.0)	20 (36)
Pittsburgh, PA	10 (7)	37 (38)	10.5 (12.6)	22 (35)
Portland, ME	NA	NA	6.6 (6.6)	15 (16)
Portland, OR	12 (9)	37 (36)	7.3 (7.5)	24 (28)
Providence, RI	17 (6)	52 (37)	8.8 (6.7)	19 (17)
Raleigh, NC	9 (5)	33 (36)	NA (7.8)	NA (15)
Richmond, VA	12 (6)	43 (35)	NA (7.1)	NA (15)
Riverside, CA	30 (18)	73 (57)	14.7 (13.9)	34 (36)
Rochester, NY	9 (NA)	NA	6.8 (6.2)	16 (16)
Sacramento, CA	12 (9)	NA (51)	NA (10.4)	NA (50)
San Antonio, TX	7 (6)	39 (40)	NA (8.1)	NA (19)
San Diego, CA	15 (9)	50 (50)	NA (9.3)	NA (26)
San Francisco, CA	17 (12)	51 (56)	11.6 (12.0)	45 (45)
San Jose, CA	17 (12)	51 (50)	10.7 (10.2)	42 (42)
Seattle, WA	20 (11)	45 (45)	8.4 (8.4)	29 (39)
St. Louis, MO	11 (11)	45 (46)	8.5 (9.9)	20 (21)
Tampa, FL	10 (4)	NA (29)	NA (7.9)	NA (18)
Washington, DC	15 (11)	55 (47)	NA (9.0)	NA (20)

Summary

- Average near-road increment from 2013-2018 is 7 ppb for NO₂ and 1.0 μg m⁻³ and PM_{2.5}
- Hourly near-road NO₂, NO, and PM_{2.5} increments showed distinct diurnal cycles
 - NO and PM_{2.5} increments peak during the morning rush hour (5-8am local time) at 25 ppb and 1.8 μg m⁻³
 - NO₂ increment peaks at 9 ppb during the early afternoon (2-4pm local time)
- Longer term trends of the NO₂ and PM_{2.5} near-road increment at the Elizabeth, NJ near-road-like site indicates gradual decreases over time since the mid-2000s
- Majority of CBSAs had their maximum annual and 1-hour NO₂ design values at the near-road site
- 50% of the CBSAs had their maximum annual PM_{2.5} design value at the near-road site
- Only 10% of the CBSAs had their maximum 24-hour PM_{2.5} design value at the near-road site