The future of LA air quality

Key ideas

- **Four separate but linked issues:**
  - **ozone**
  - **particulate matter (PM2.5)**
  - **environmental justice (spatial patterns of pollutants)**
  - **greenhouse gas emissions**

- **Ingredients for ozone and PM are similar (and linked to CO_2):**
  - **volatile organic chemicals (VOC)**
  - **nitrogen oxides**
  - **sunlight**
  - **also sulfate and ammonia**

https://cpo.noaa.gov/News/News-Article/ArtMID/6226/ArticleID/2182/Air-Quality-in-the-Los-Angeles-Basin-Increasingly-Dependent-on-Temperature

VOC

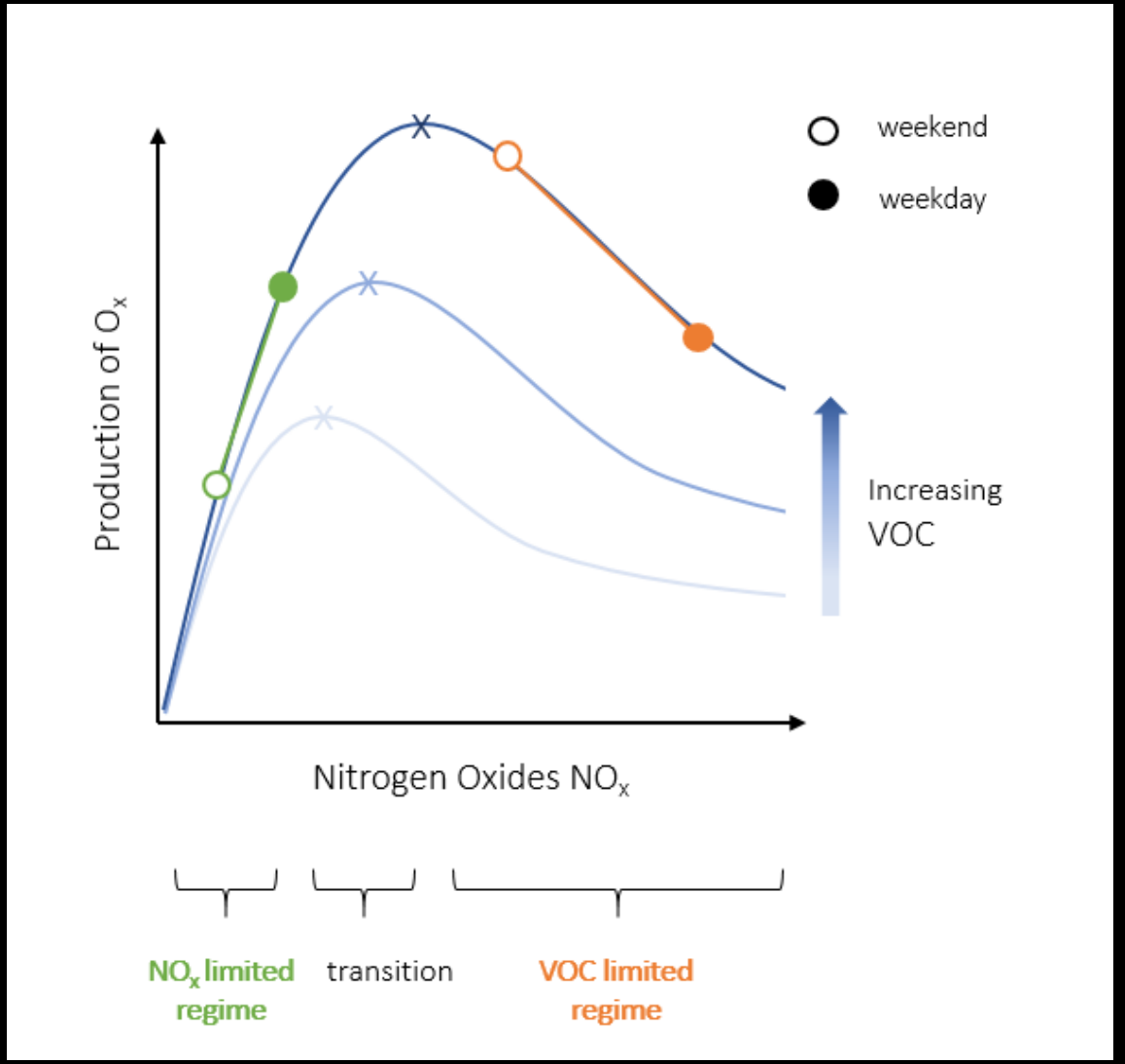
- In the last 40 years gasoline use (mostly cars, but also leaf blowers etc.) has been the primary source of the organic molecules that contribute to ozone and aerosol.

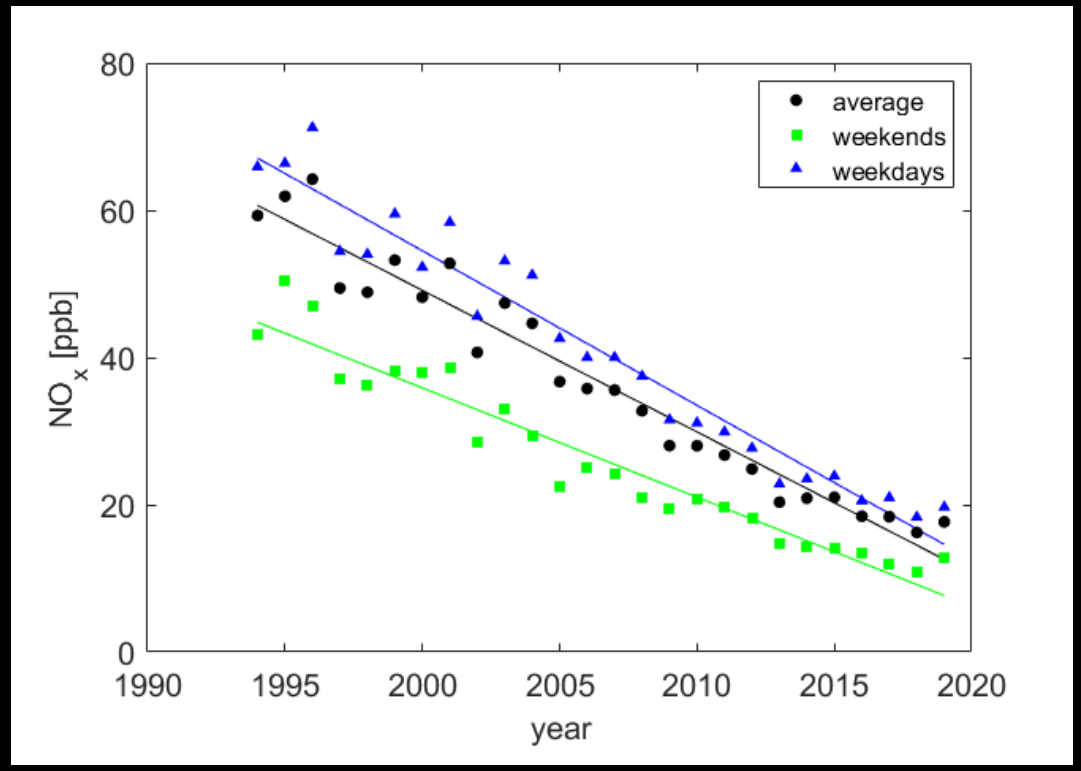
- Catalytic convertors are incredible technology. Today other sources of VOC are almost equal in importance. At high temperatures, other sources are more important than cars.

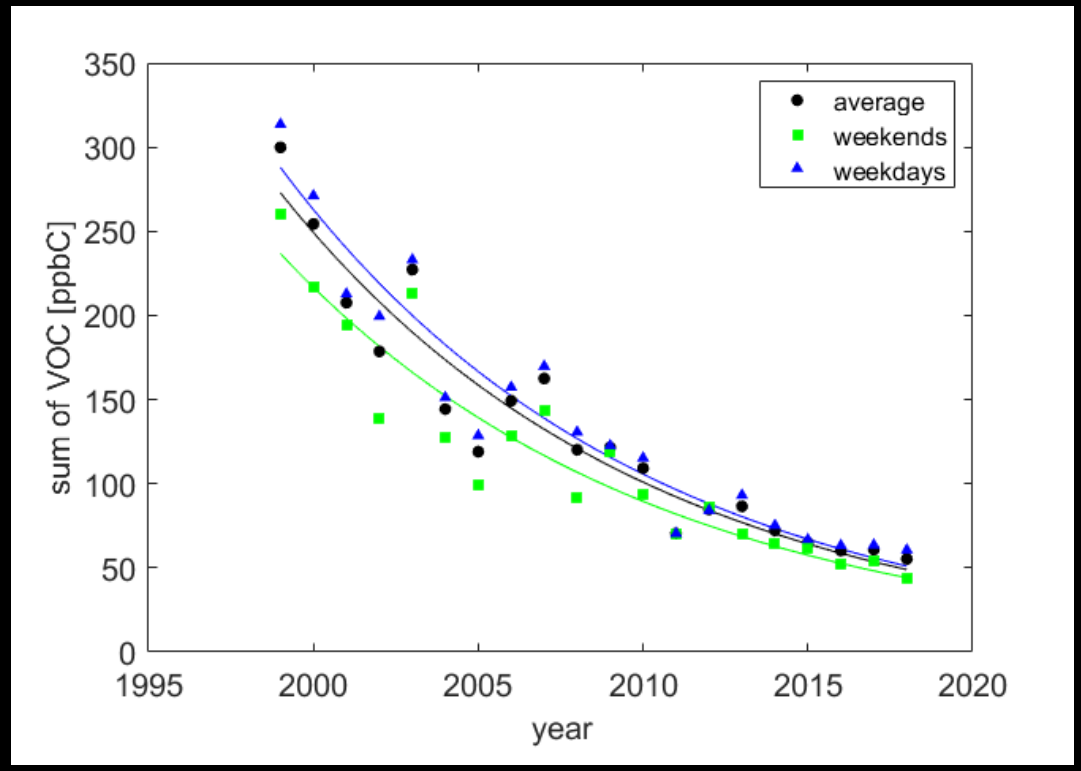
NO_x

- Again catalytic convertors are incredibly effective. Today heavy duty diesel trucks are half the nitrogen oxide source and cars the other half.

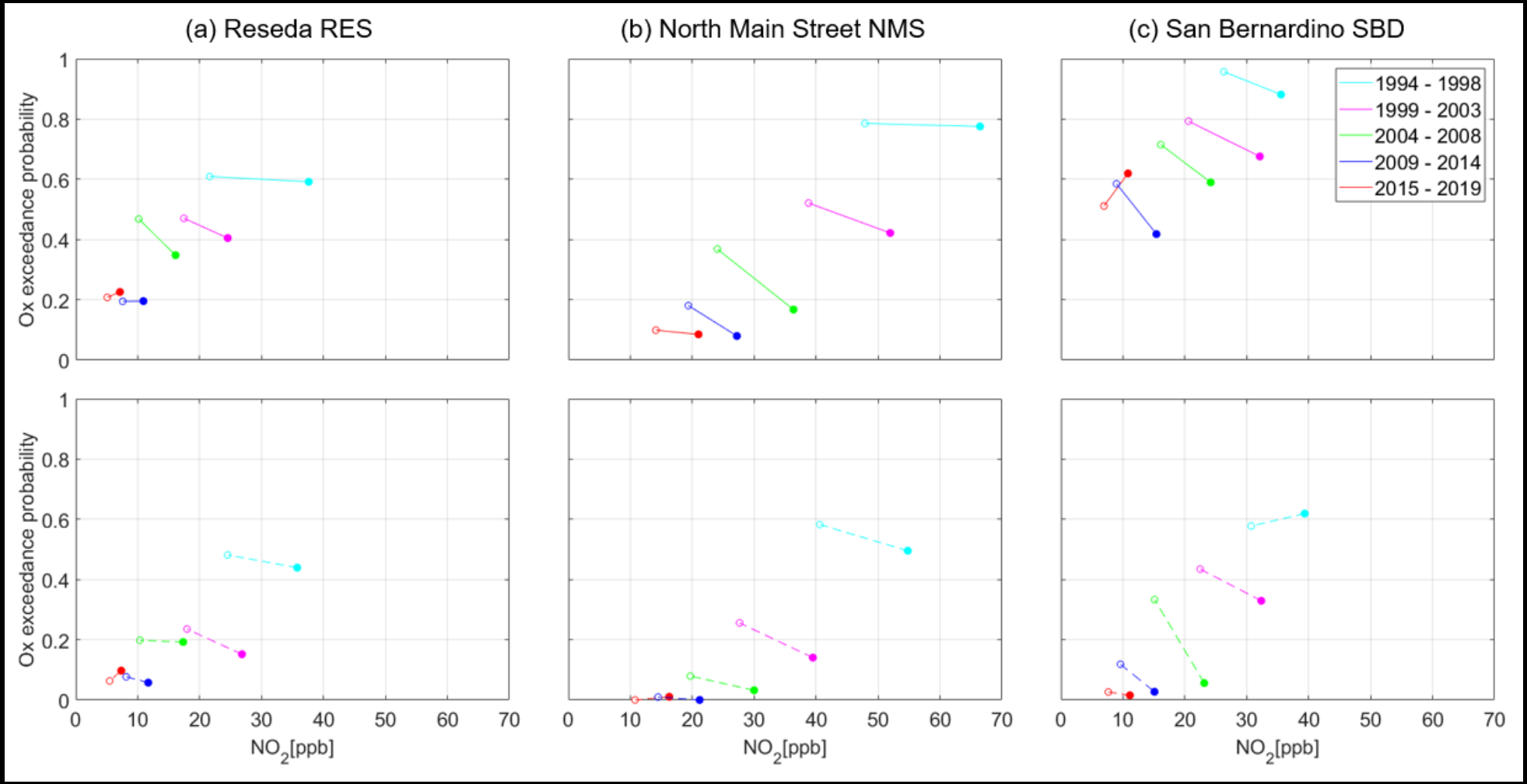
Ozone Chemistry




80
60
40
20
0
1990
1995
2000
2005
2010
2015
2020
year
NO_x [ppb]
average
weekends
weekdays


350
300
250
200
150
100
50
0
1995
2000
2005
2010
2015
2020
year
sum of VOC [ppbC]
average
weekends
weekdays

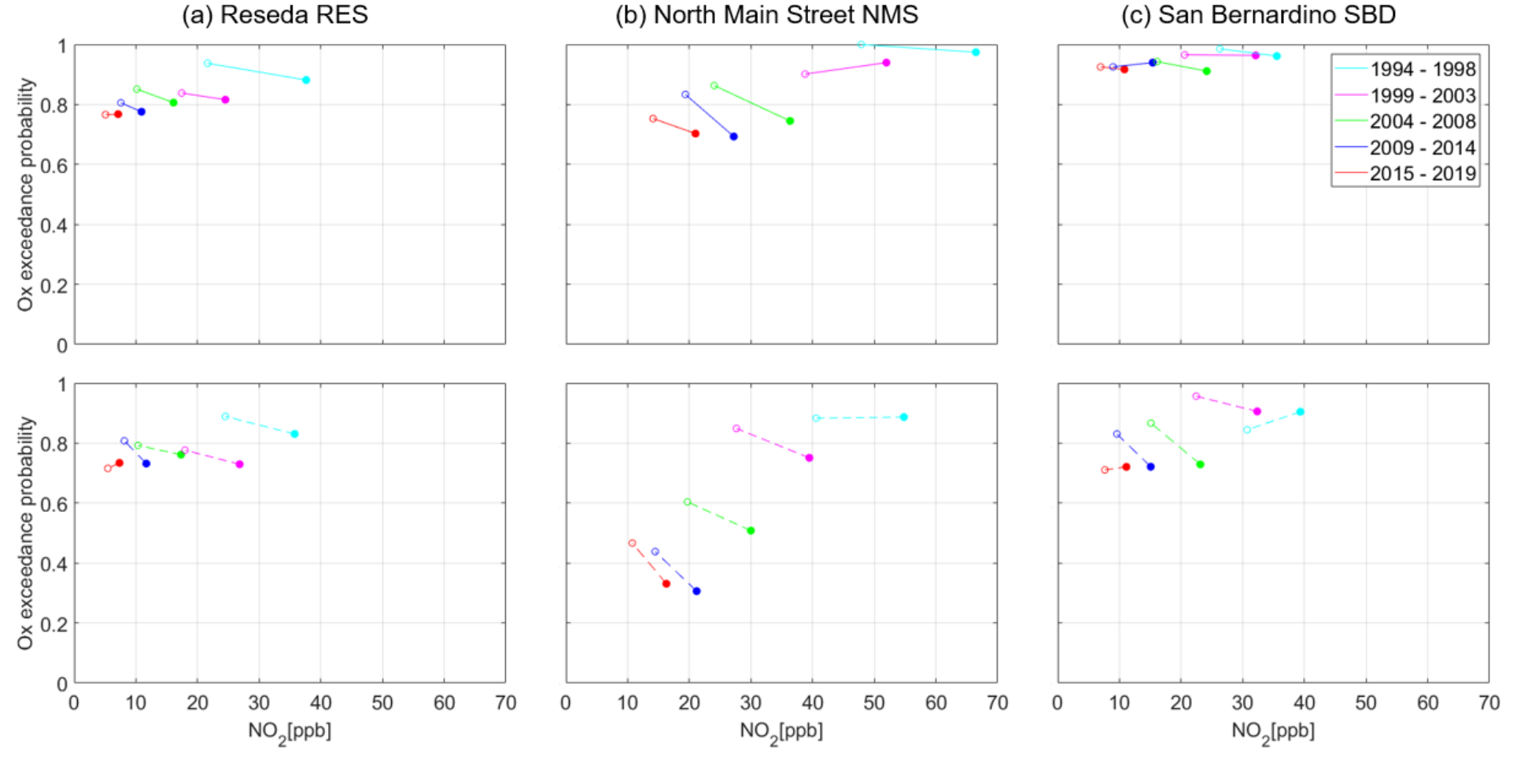
Odds of ozone exceeding 100ppb



Hot
(above 30C)

Cooler
(25-29CF)

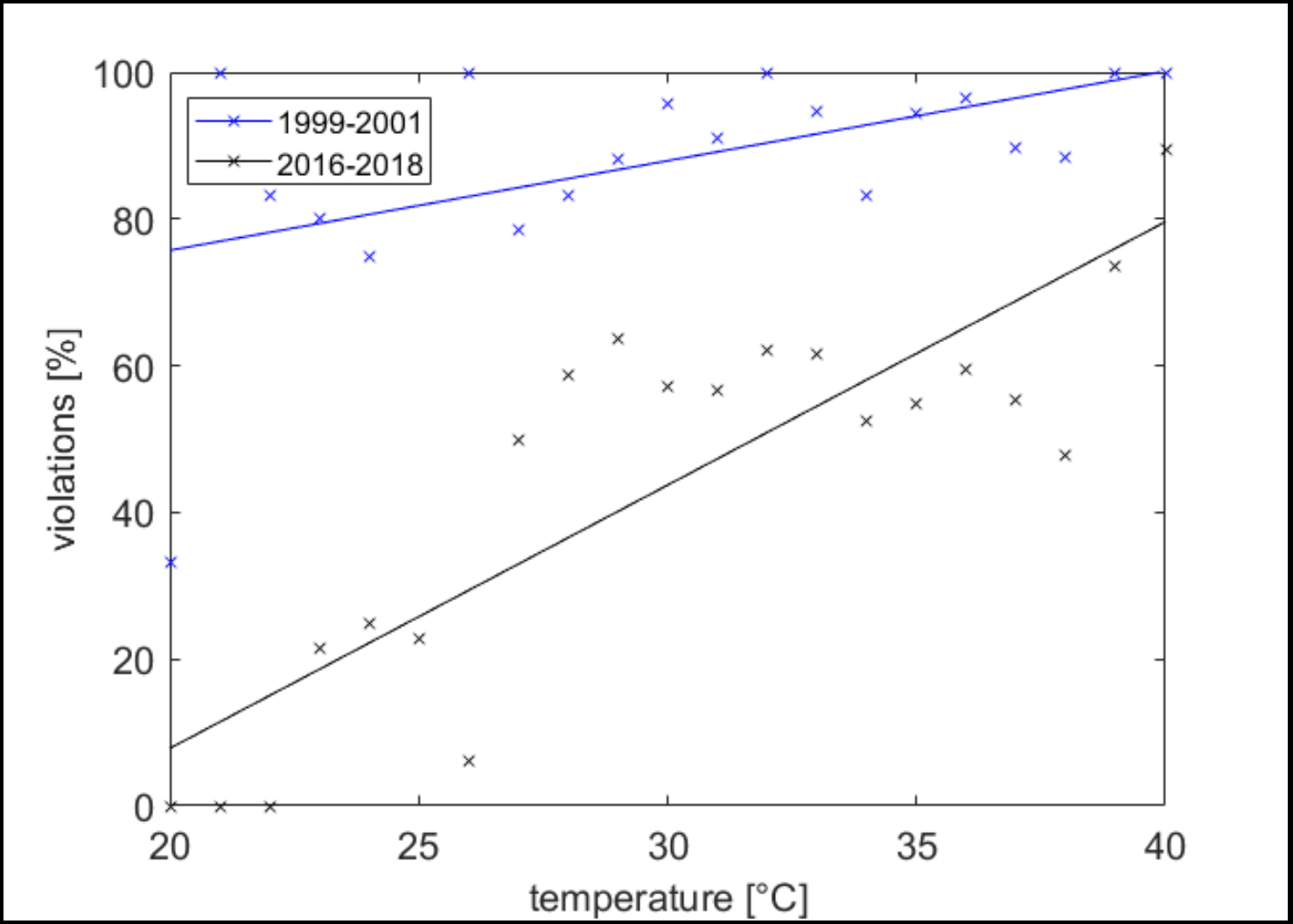
Odds of ozone exceeding 70ppb



Hot
(above 30C)

Cooler
(25-29CF)

The occurrence of poor air quality on cooler days has been dramatically improved, on hot days less so

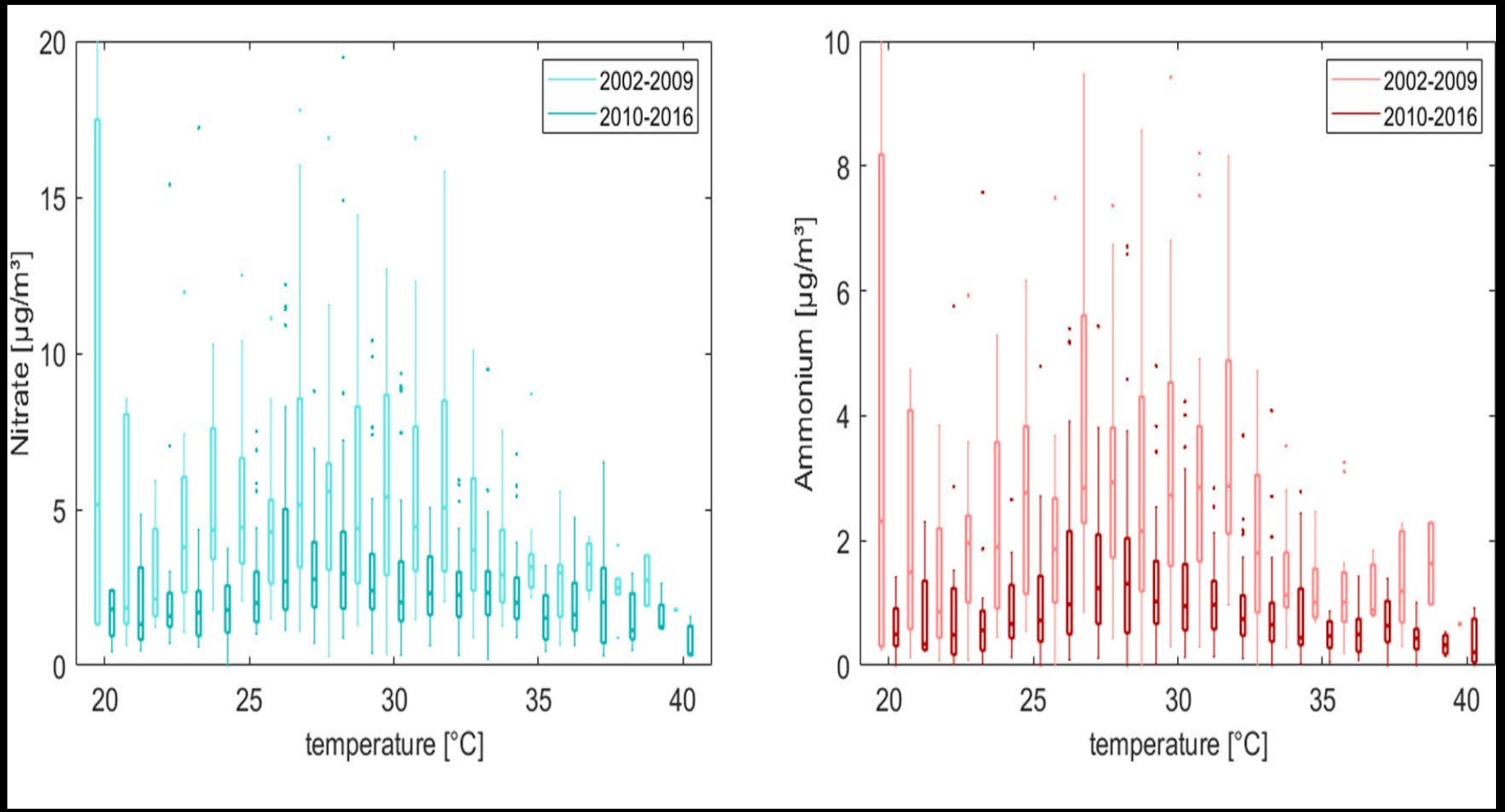


% of days in excess of the PM2.5 standard in Riverside

15 in 2000; 12 μg/m^3 in 2017

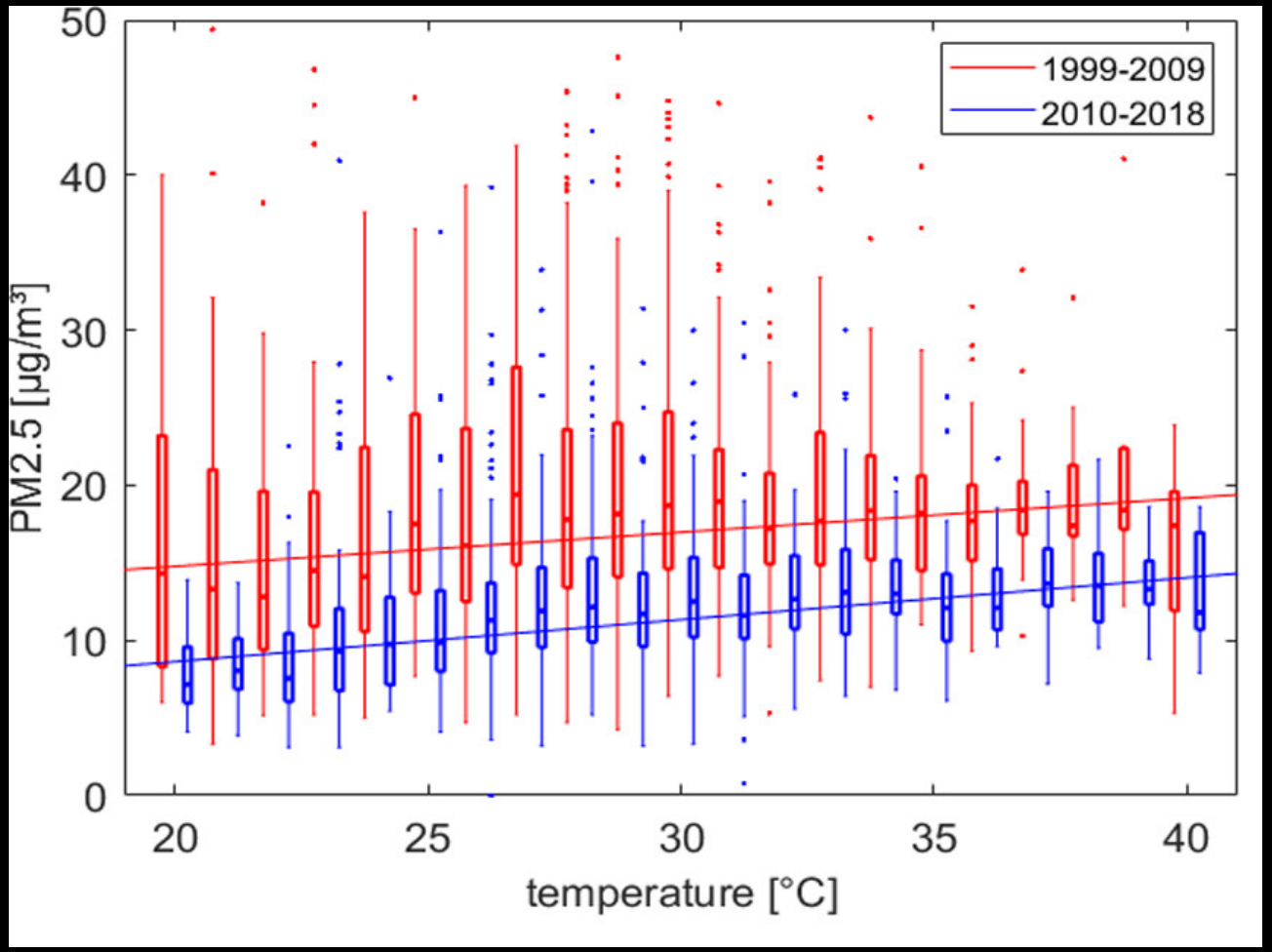
NH_4NO_3 is almost gone – reductions in NO_x emissions have worked fro aerosol

C. Nussbaumer and RCC, ES&T, 2020 and 2021.



High aerosol events (non-fire) are increasing correlated with temperature

C. Nussbaumer and RCC, ES&T, 2020 and 2021.



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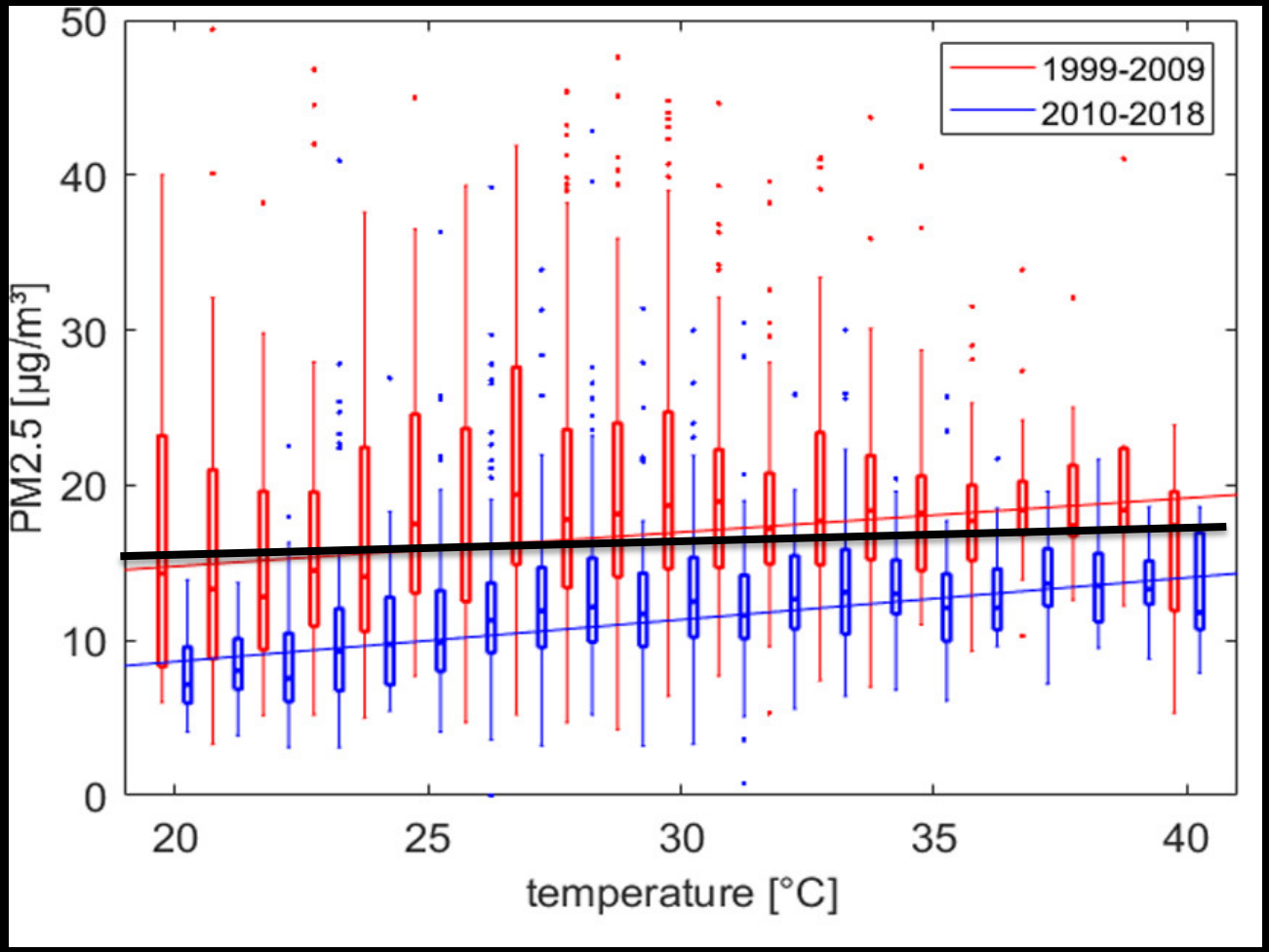
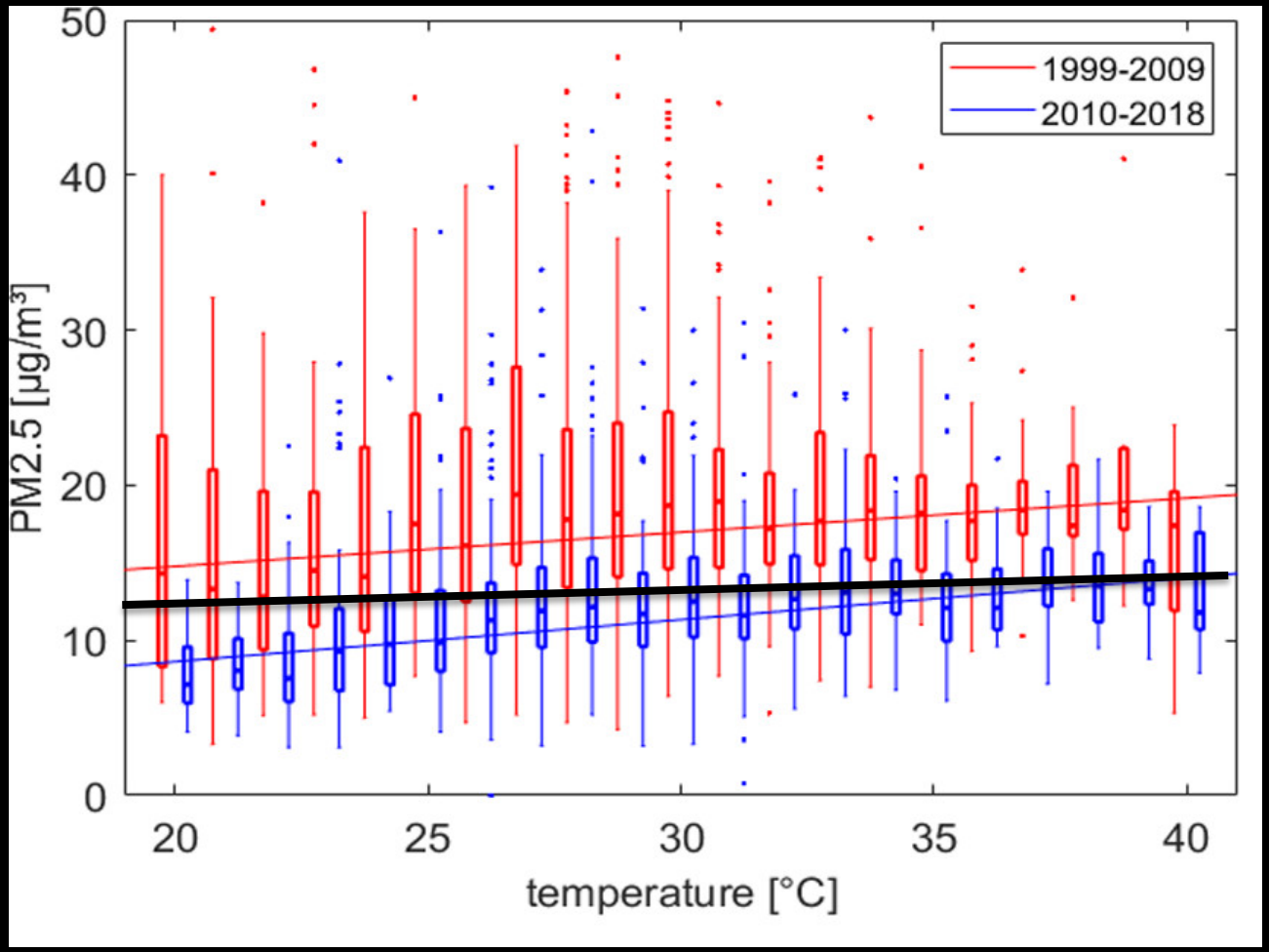
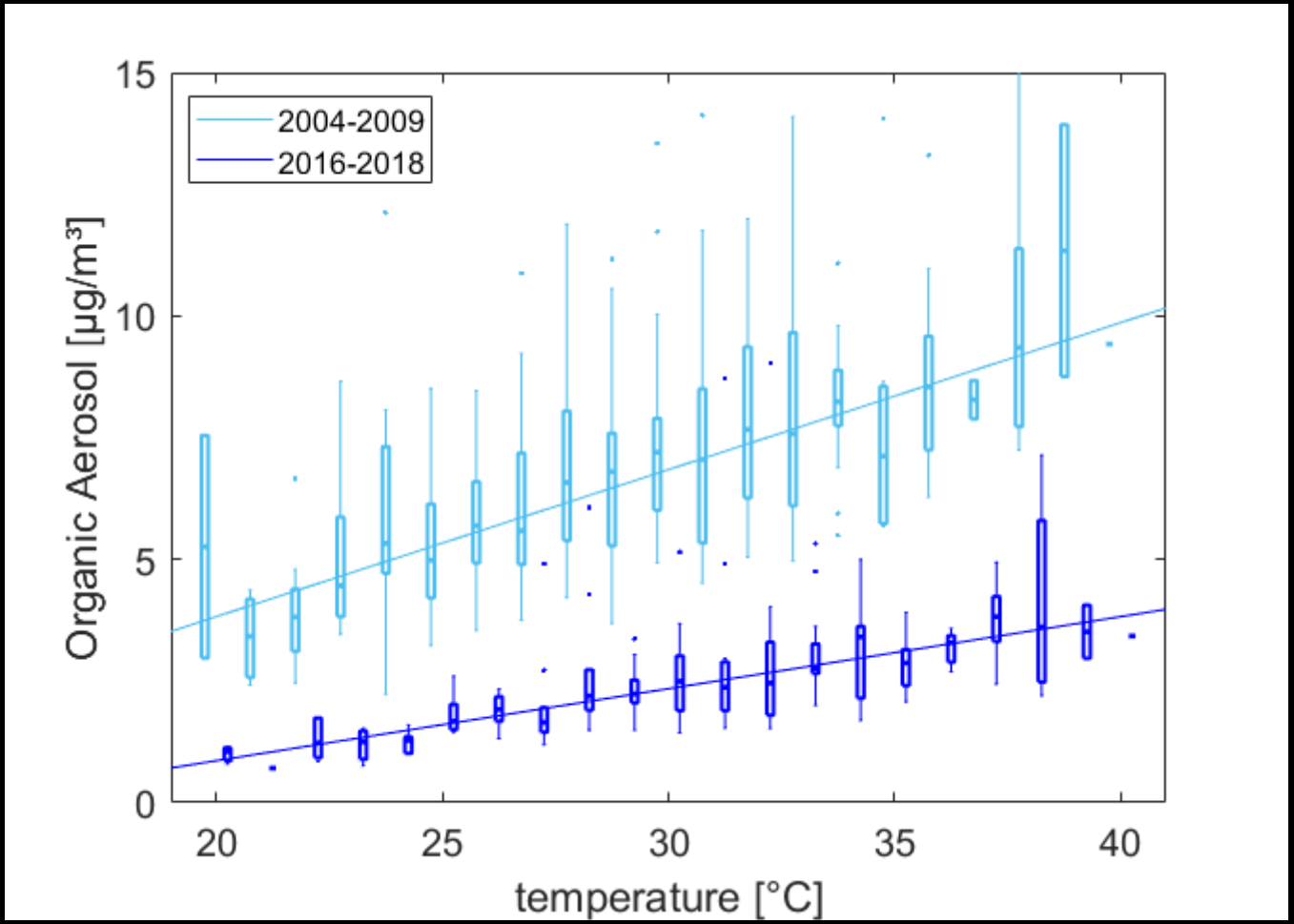



1999-2009
2010-2018
PM2.5 [μg/m³]
temperature [°C]
0
10
20
30
40
50
20
25
30
35
40

Organic aerosol is trongly correlated with Temperature and dominates the remaining aerosol chemistry in Los Angeles

C. Nussbaumer and RCC, ES&T, 2020 and 2021.



Is this due to VOC from urban trees? Or VCP? Or ...

Shelter-in-place and LA air quality

The SIP orders of March 2020 resulted in substantial reductions in cars and trucks on the road. Also much lower use of downtown buildings and muck lower restaurant activity.

Emissions of NOx and VOC from vehicles dropped. Emissions of primary particles from cooking dropped (or were relocated to homes).

Shelter-in-place and LA air quality

- Emissions of NO_x and VOC from cars were reduced
- Weather was unusually warm for April

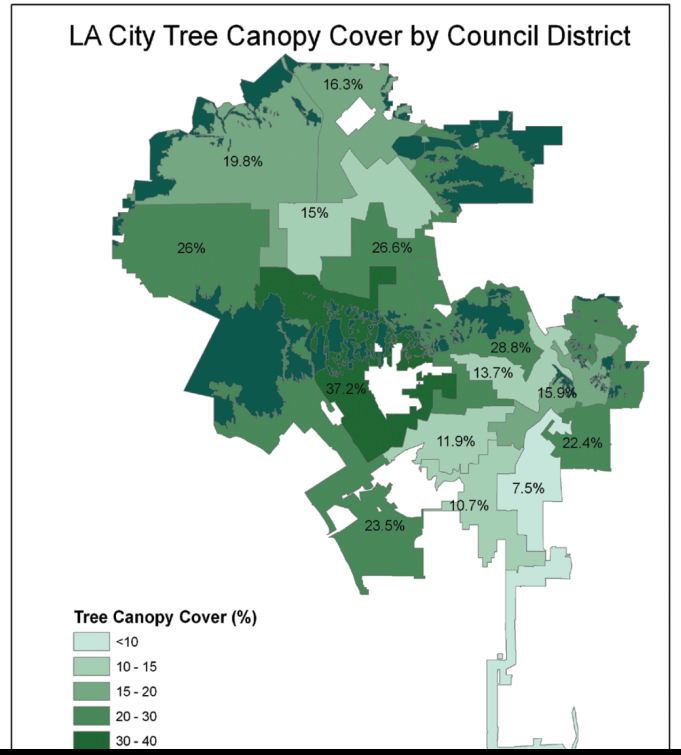
Result—ozone was high, similar to higher ozone on weekends. Effects on aerosol were hard to detect.

The benefits of one Million Trees in LA

Million Trees LA

Mayor Antonio Villaraigosa of the City of Los Angeles has charted a course for sustainable growth, and the region's community forest is a critical component of that vision. In September 2006, the mayor announced his plan to plant **one million trees** over the next several years. The Million Trees LA initiative draws attention to the importance of urban forests for the **economic, environmental, and social health** of Los Angeles.

For help in carrying out its plans, the city of Los Angeles called upon the Center for Urban Forest Research to answer some questions: How green is LA today? Is there room for a million trees? Where should we plant them? What environmental and other benefits will our trees



about 11 million trees. The number of trees in an area is closely related to land use, so the more industrial and commercial parts of the city have the least amount of tree canopy cover (7%), and the low-density residential parts of the city have the most (37%).

Is there room for a million trees?

And where will they go? These weren't easy questions to answer. How do you find and count all the little spaces a tree can fit in a city of almost 500 square miles? With computers, of course.

First, the computer "masked out" areas where there were already trees, buildings, paved surfaces, and bodies of water. In the remaining pervious surfaces (grass and bare soil), the computer tested each potential site for whether a tree would fit, beginning with large trees (50 ft in diameter)

Summary, conclusions and your questions