Can Satellite Data Drive Public Policy?

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NOAA
National Satellite and Information Service
Center for Satellite Applications and Research

EPA NAAQS daily and annual standards

- The US EPA sets **National Ambient Air Quality Standards (NAAQS)** in order to regulate air pollution.

New York city smoke from Canadian fire in June 2023

https://www.nbcnewyork.com/local/wildfire-smoke-photos-in-nyc-show-apocalyptic-sepia-landscape/4405485/

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  - Show that the state has adequate air quality management program to implement NAAQS
  - **Provides state-adopted control measures in order to reach and maintain air pollutant concentrations below the NAAQS**

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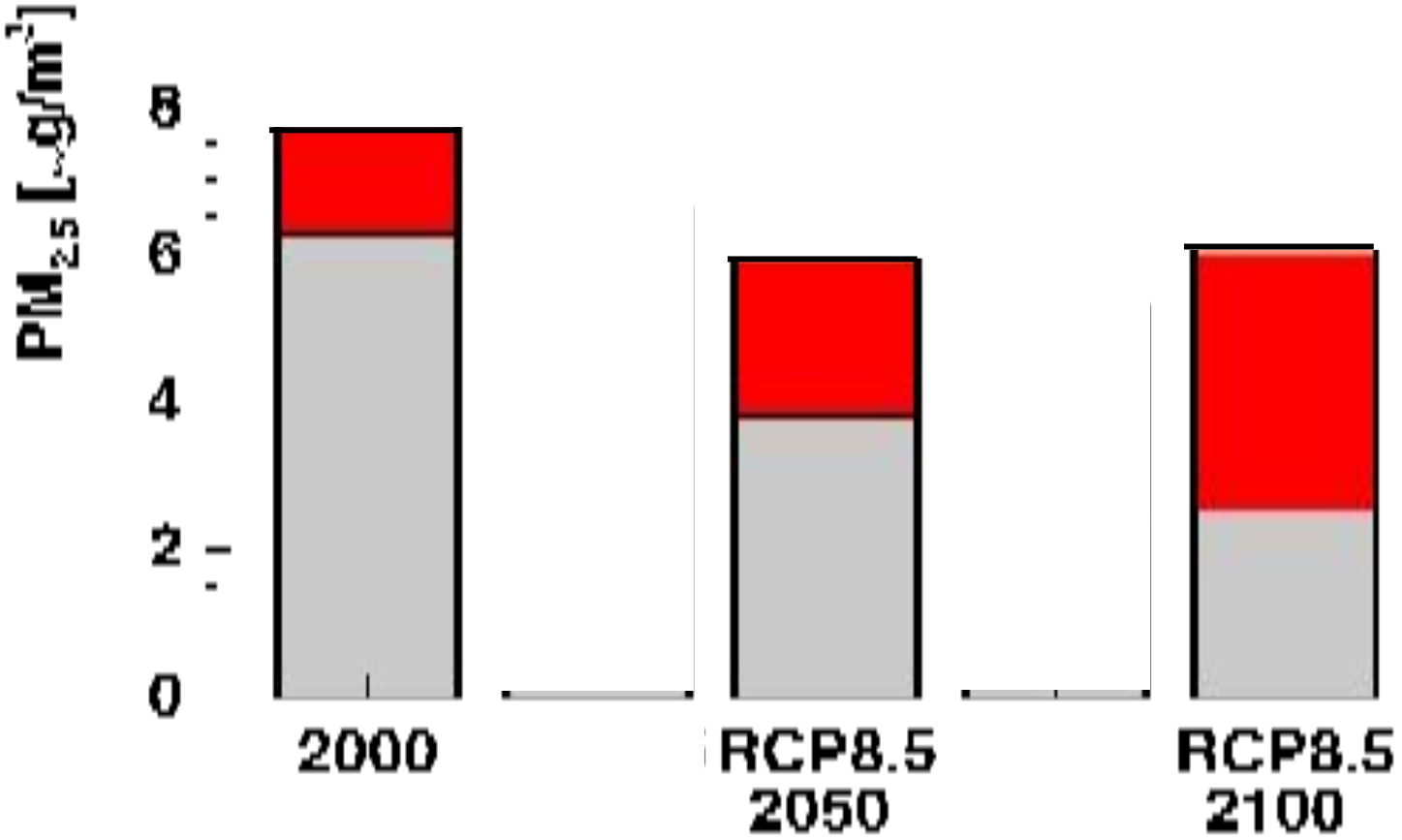
Landscape fires are becoming an increasingly important source of $PM_{2.5}$ in the US



See Ford et al. (2018), slide courtesy of Bonne Ford

The Exceptional Events Rule (EER)

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(Image credit: EUMeTrain)

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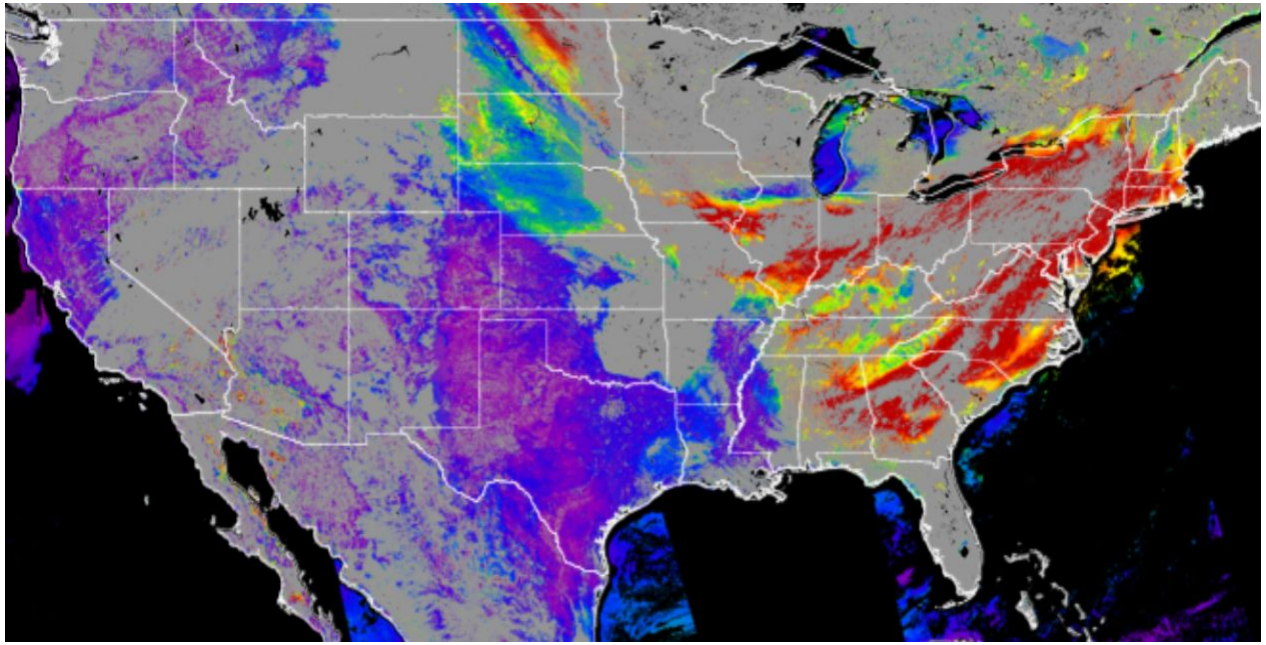
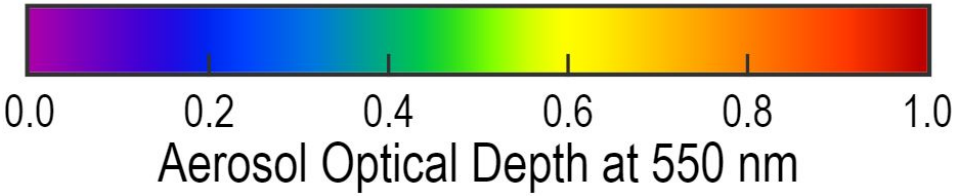
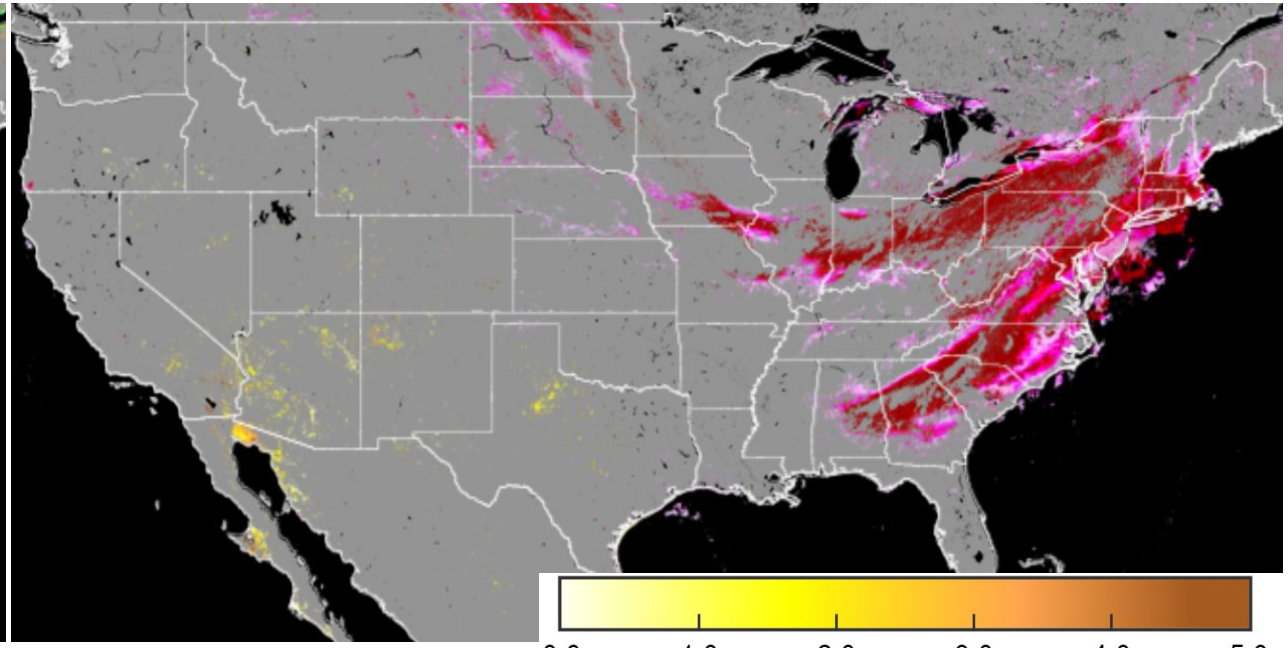
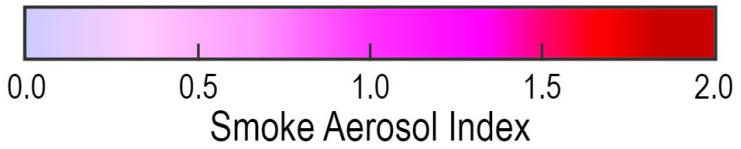
  - Wildfires
  - Dust storms
  - Volcanic emissions
- In these cases, states can take advantage of the **Exceptional Events Rule (EER)** and avoid being classified as **nonattainment.**
  - **However, exceptional events reports often reach hundreds of pages and require significant work to produce.**

Visible Infrared Imaging Radiometer Suite (VIIRS) Aerosol Products from JPSS series

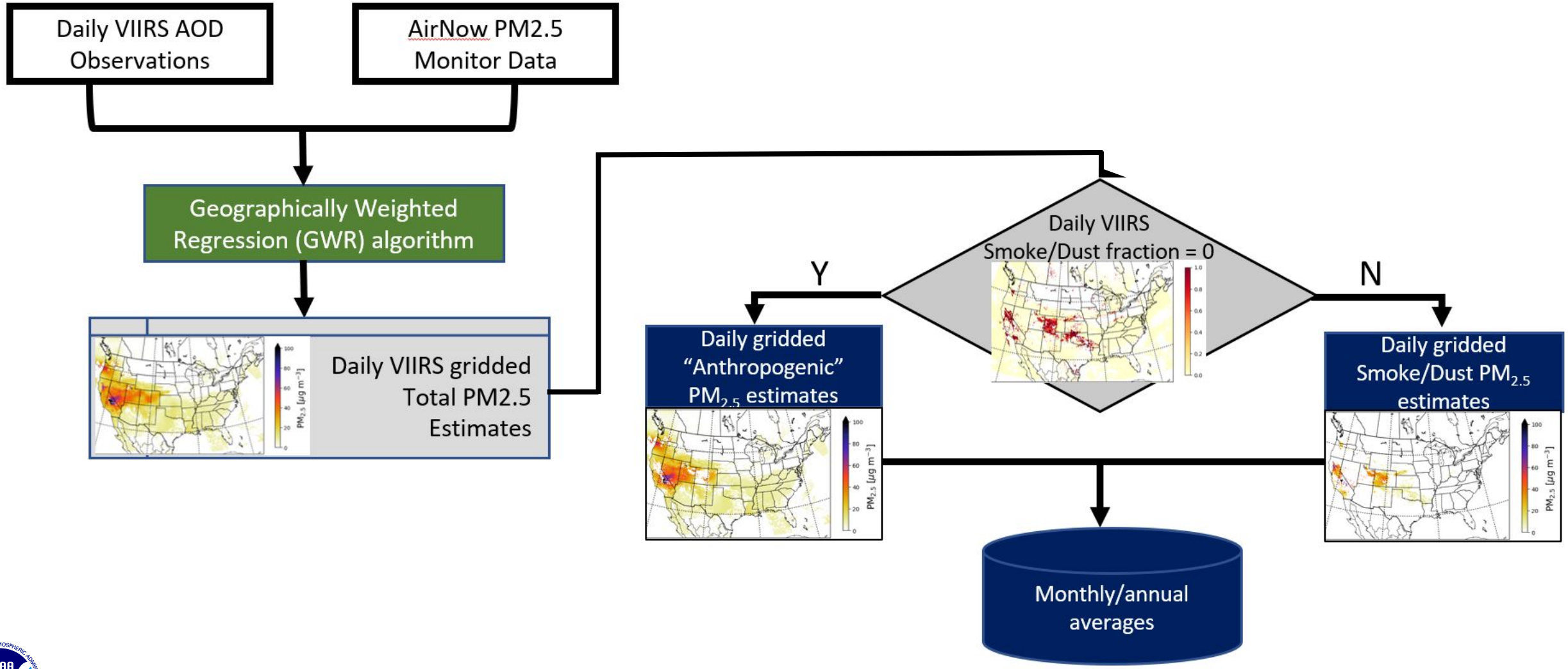




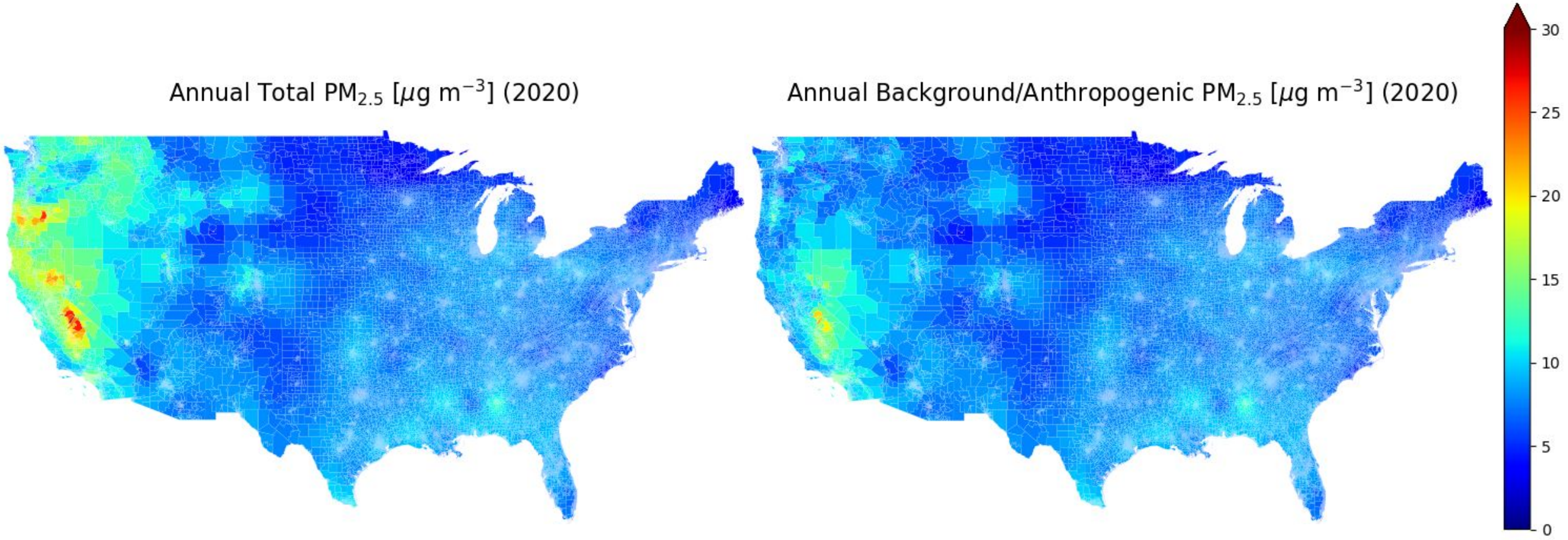




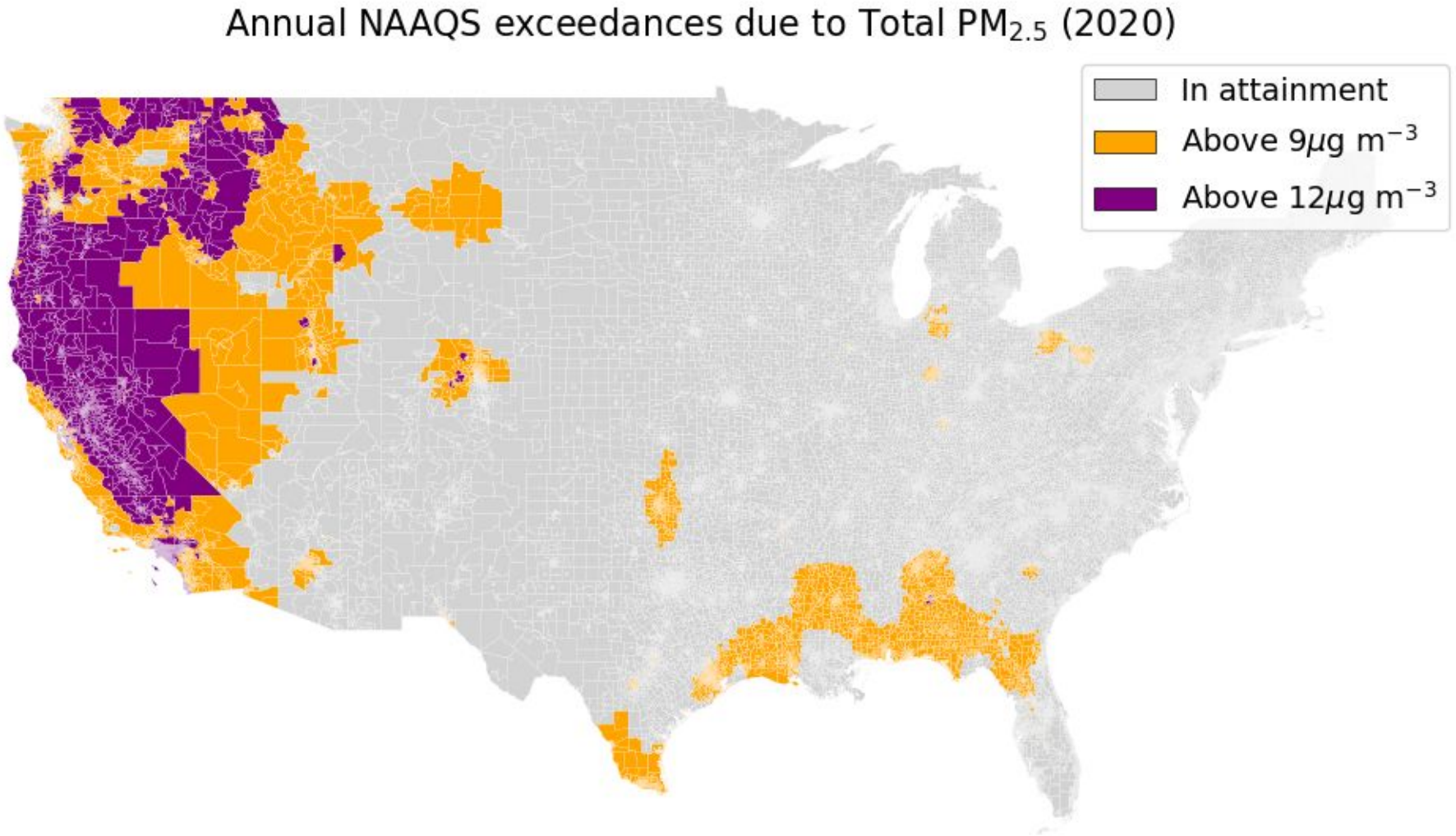
Translating satellite AOD, smoke, and dust retrievals to $PM_{2.5}$



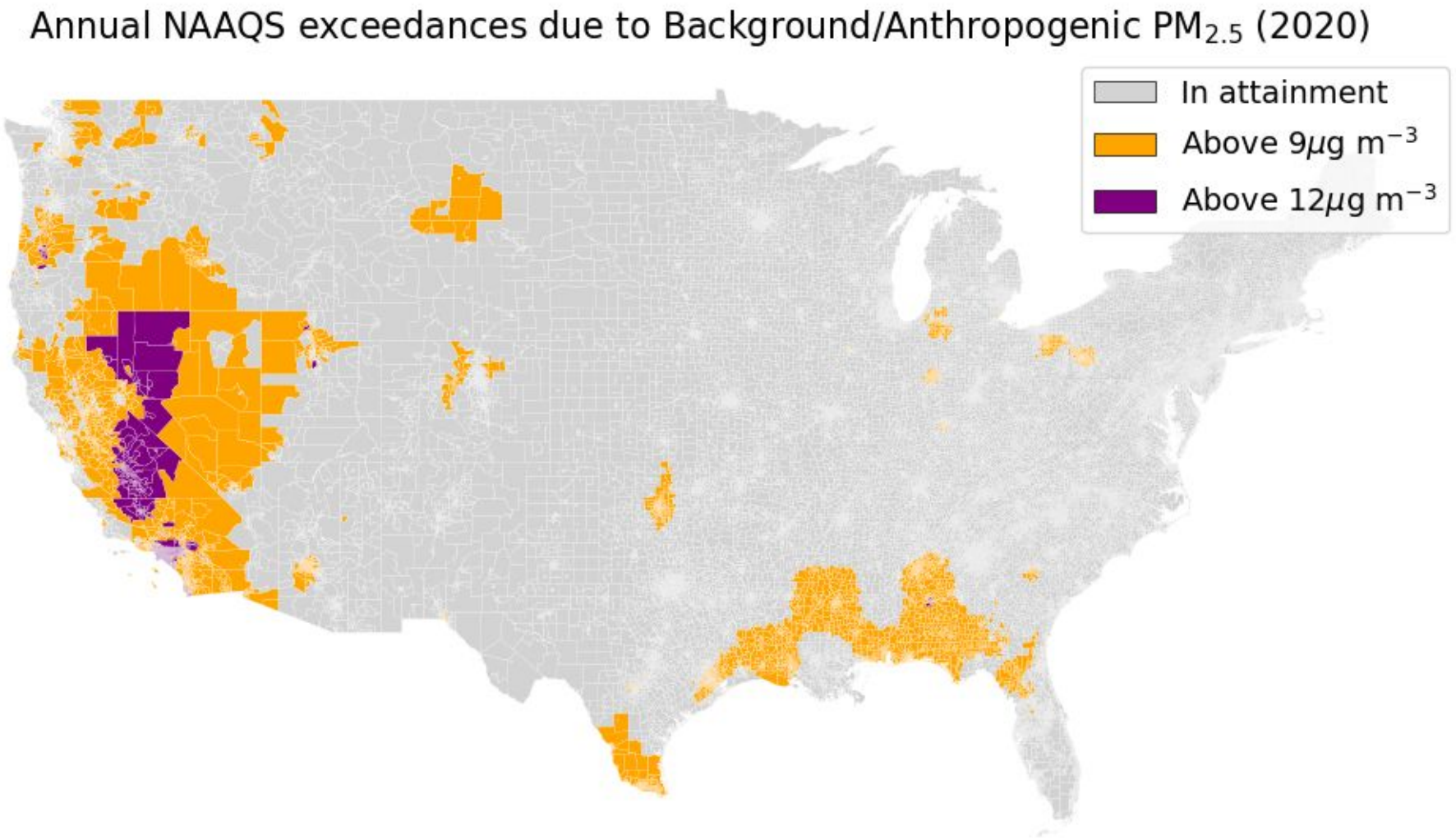
VIIRS smoke/dust retrievals are especially useful for thicker smoke plumes in the West



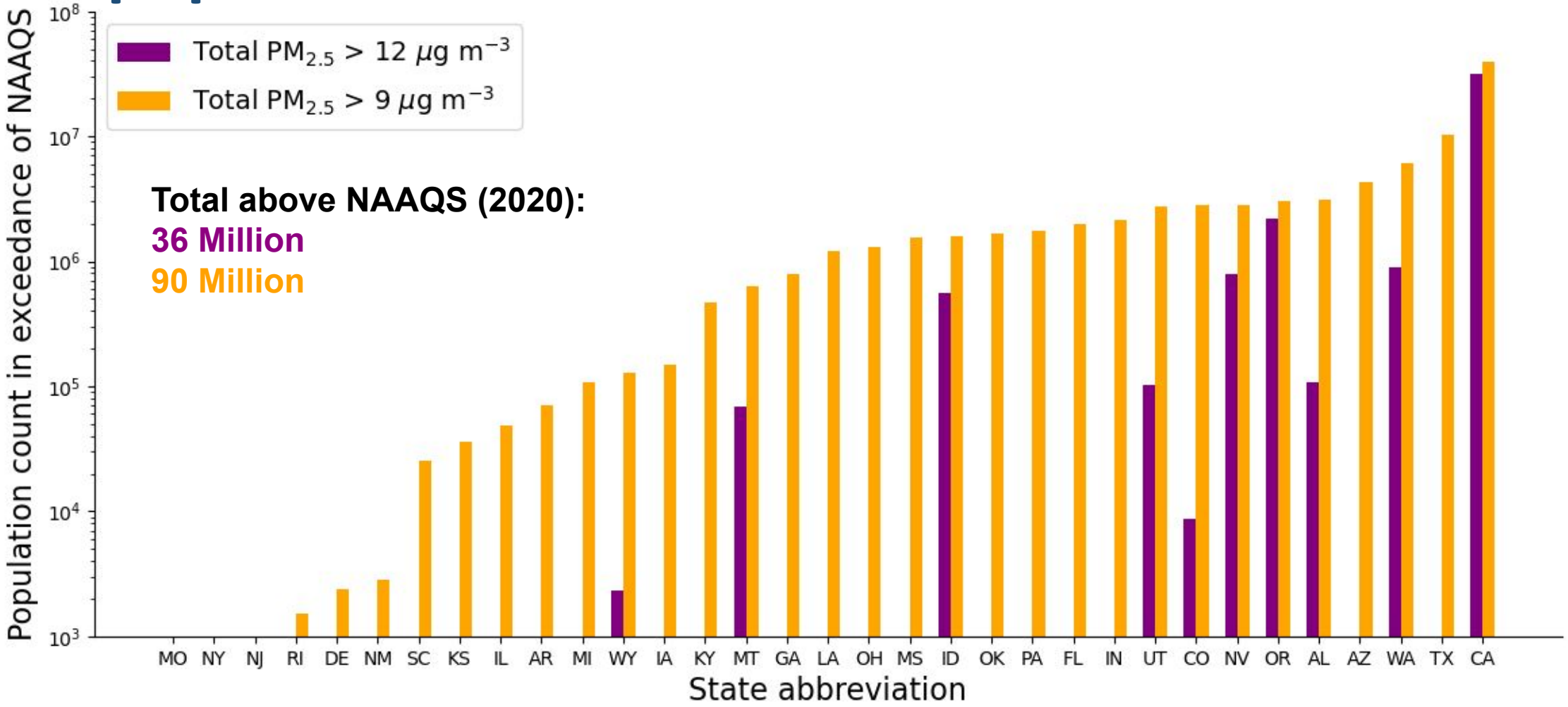
VIIRS shows smoke/dust $PM_{2.5}$ contribution to potential exceedances of NAAQS



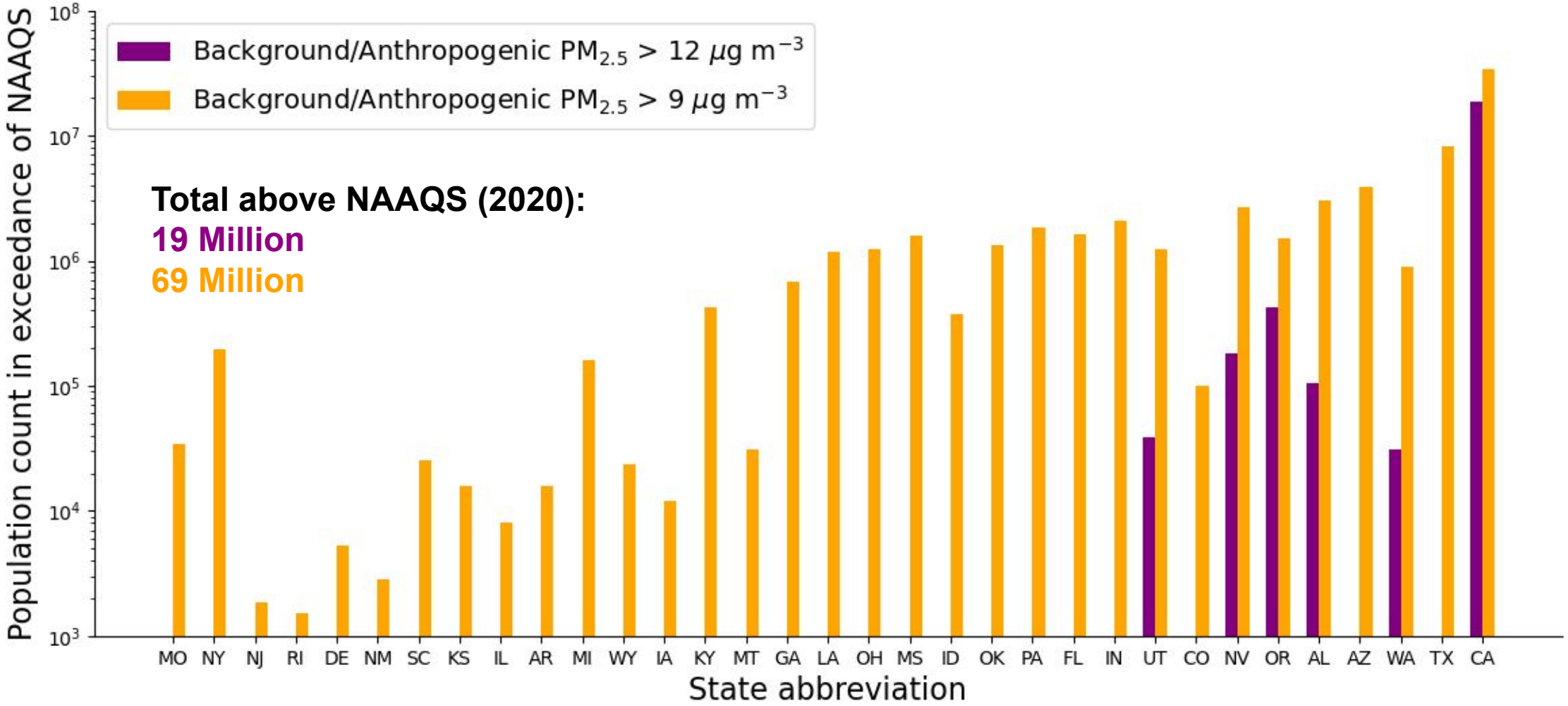
Background/anthropogenic $PM_{2.5}$ still shows large increase in 2020, which may indicate missed smoke/dust



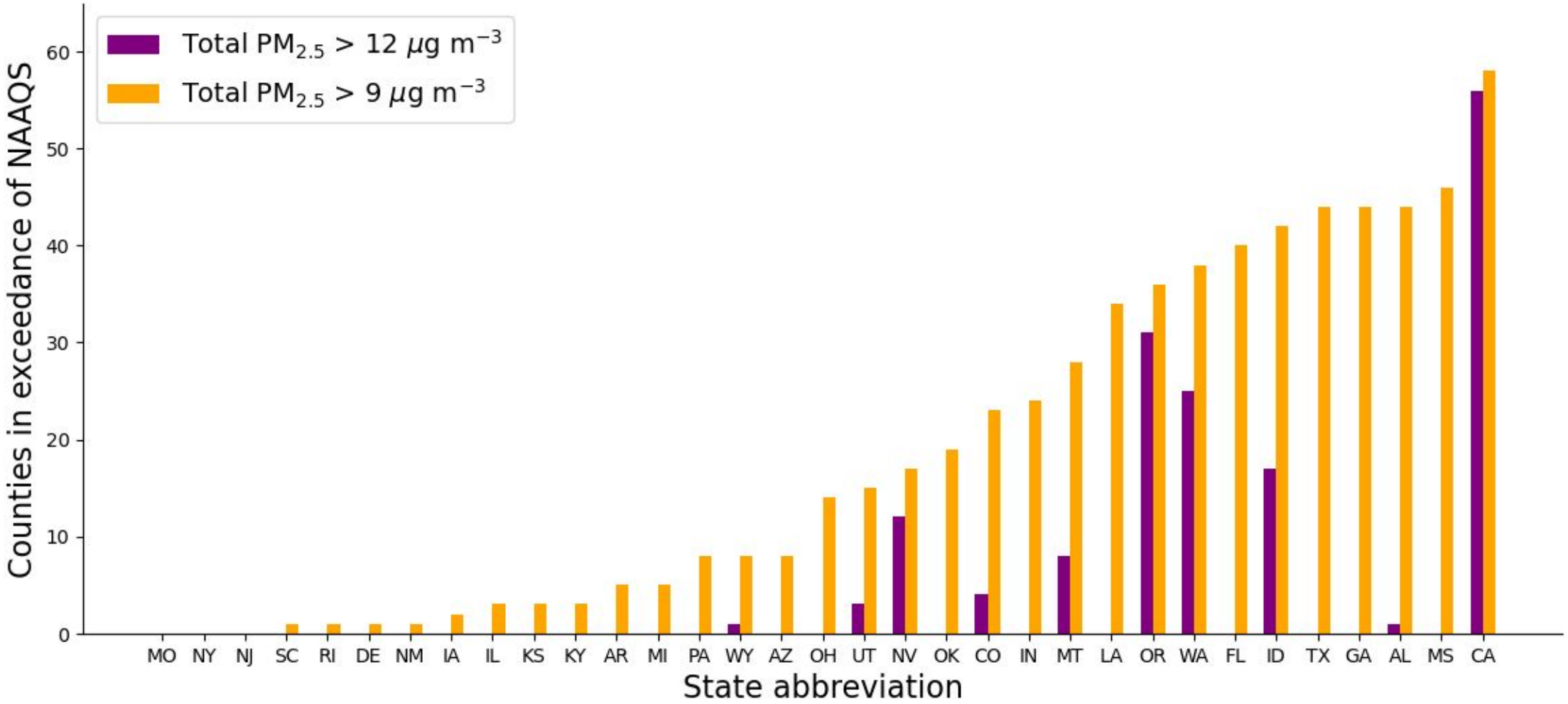
VIIRS indicates a significant increase in US population above the new annual NAAQS



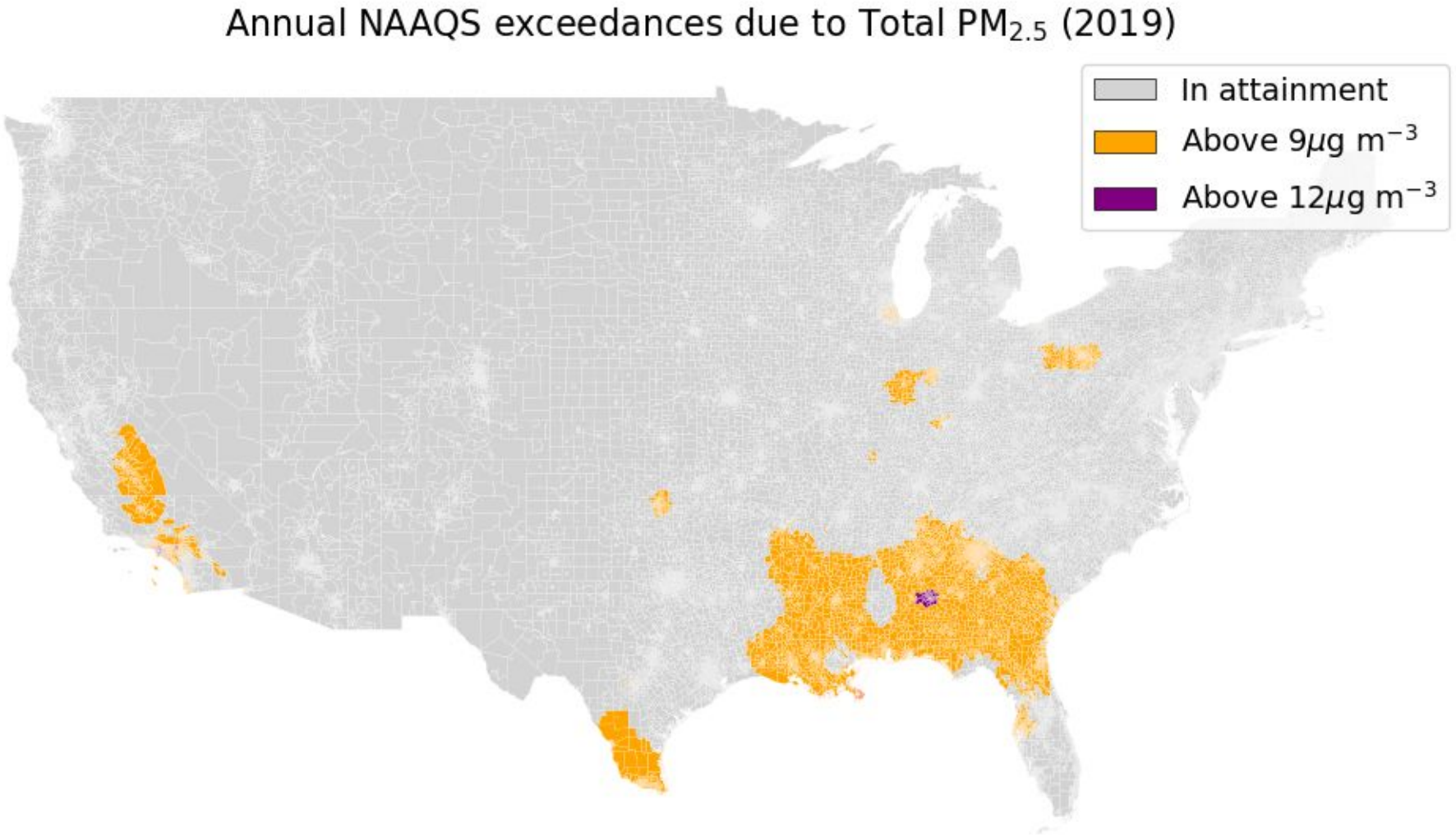
Even smoke/dust free observations indicate a large increase in NAAQS exceedance



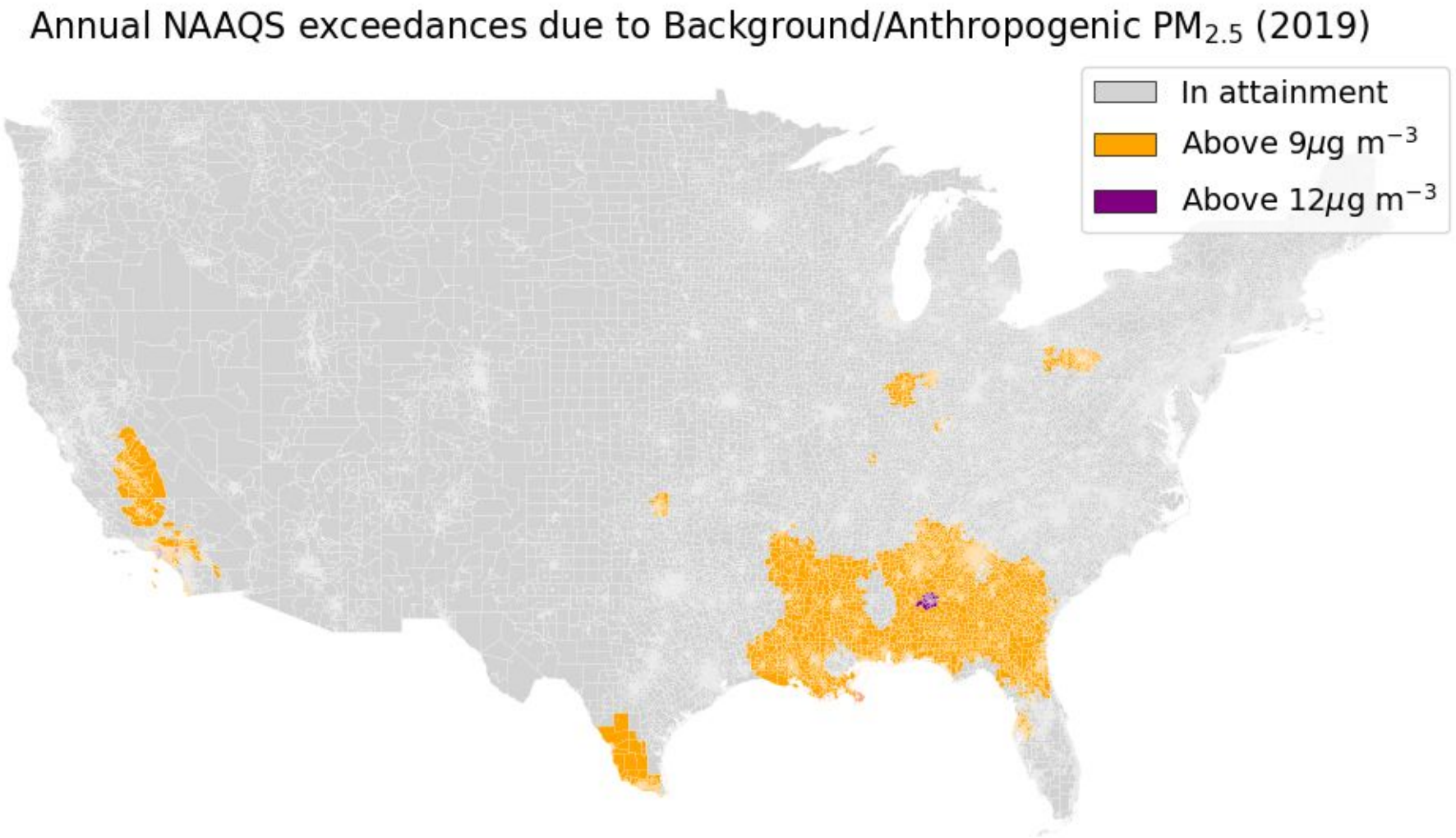
This may lead to a significant increase in county-level Exceptional Events Reports



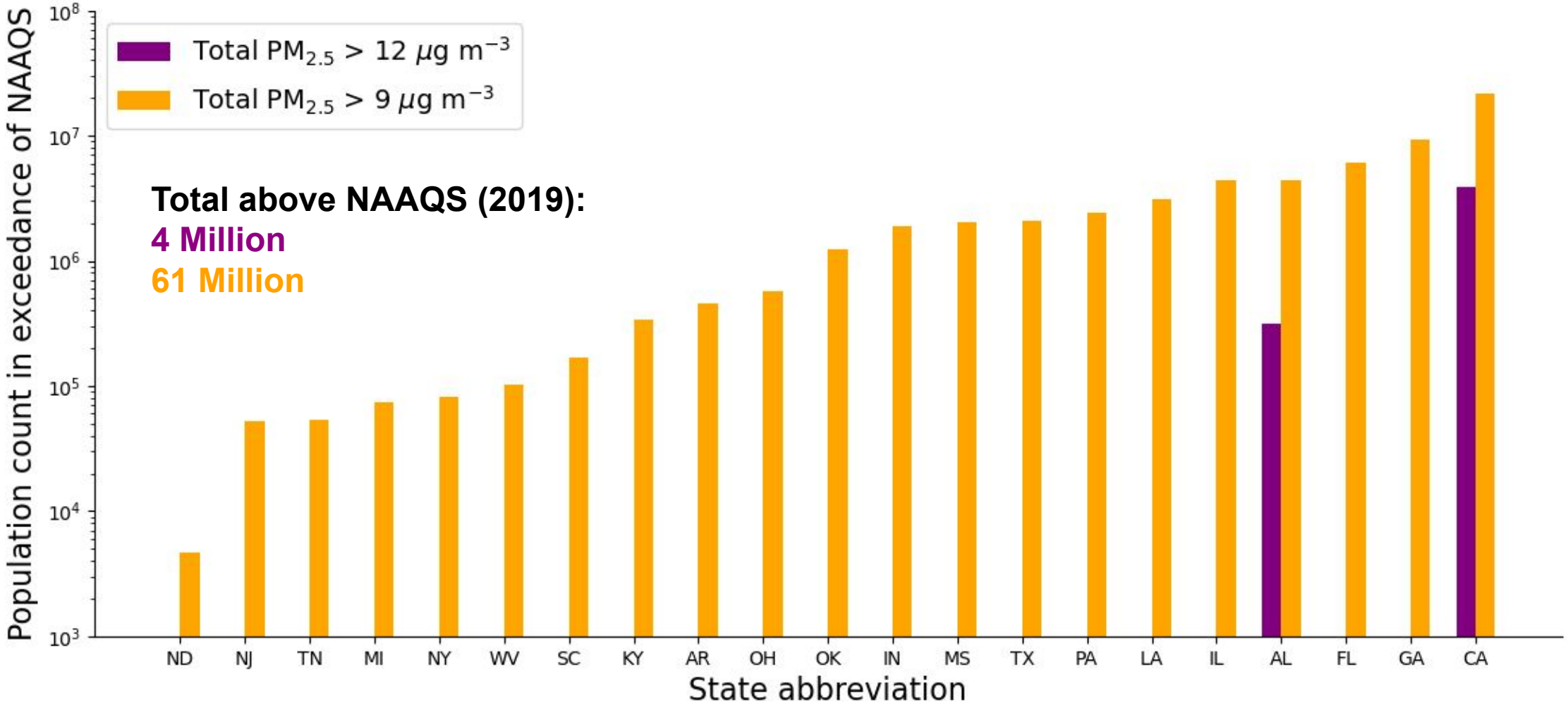
What if we look only at low-fire year? (2019)



Smoke/dust-free $PM_{2.5}$ is nearly the same as Total $PM_{2.5}$



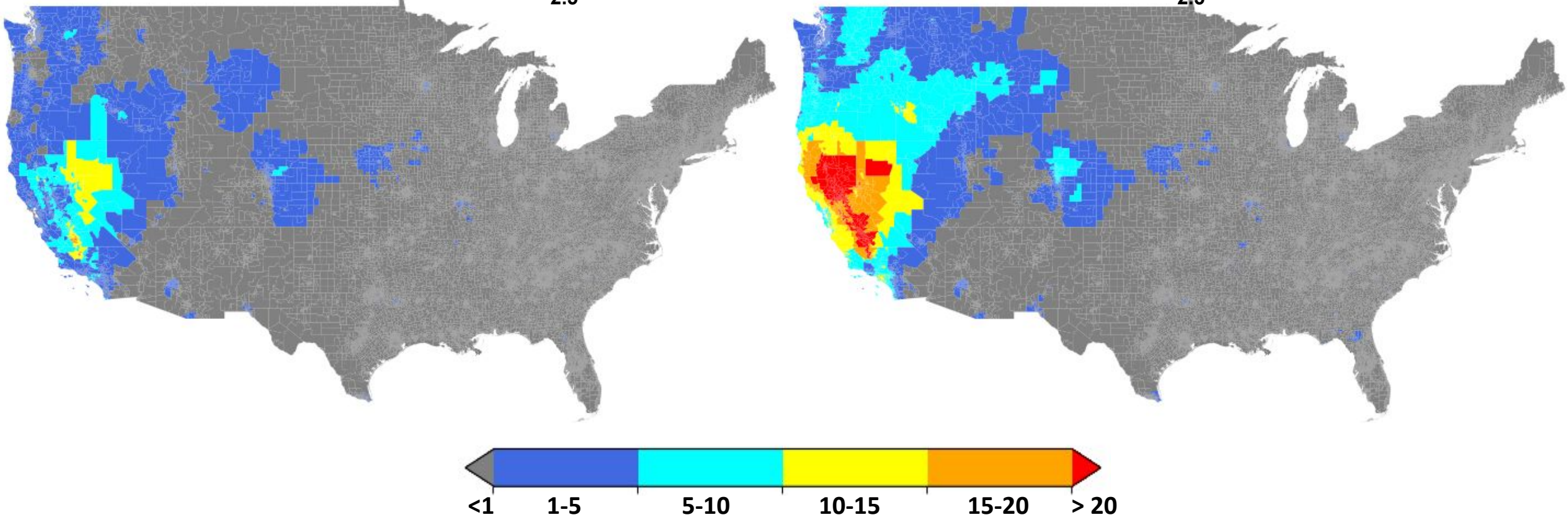
Even in a low-fire year (2019), we see a significant increase in the US population above new annual NAAQS



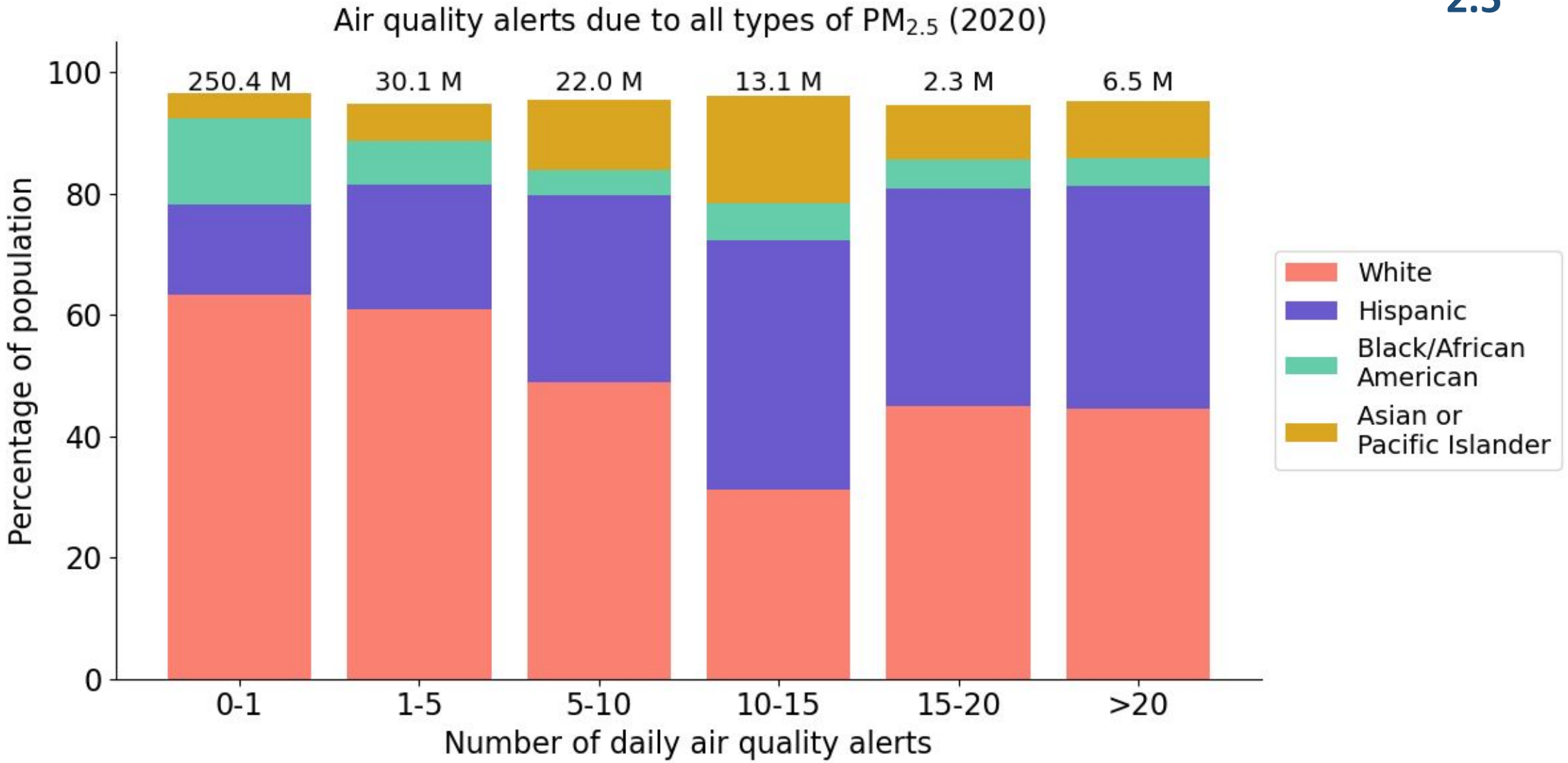
How does smoke/dust impact daily air quality disparities across the US?

Number of daily air quality alerts due to Background/Anthropogenic $PM_{2.5}$ (2020)

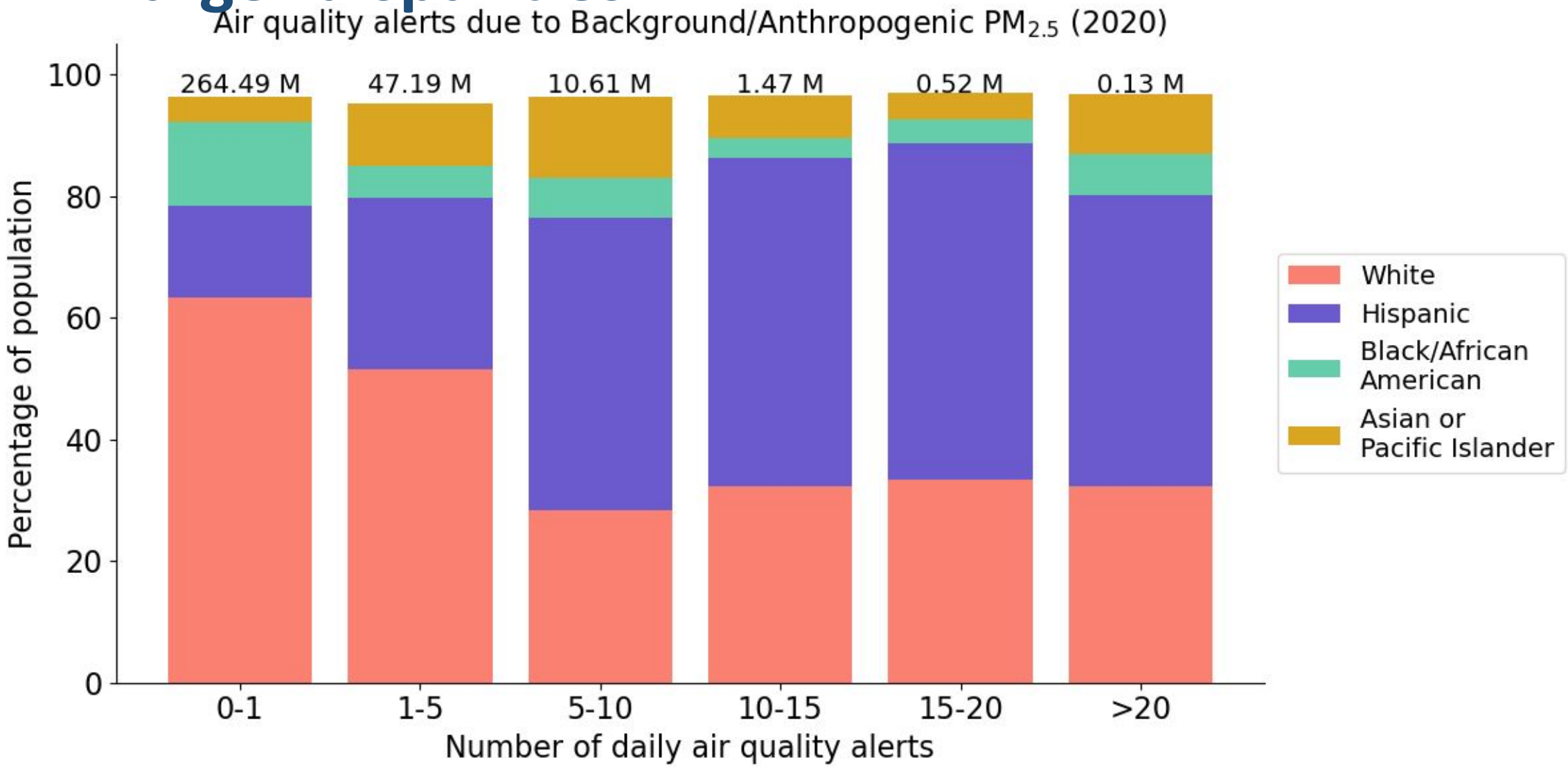
Number of daily air quality alerts due to Total $PM_{2.5}$ (2020)



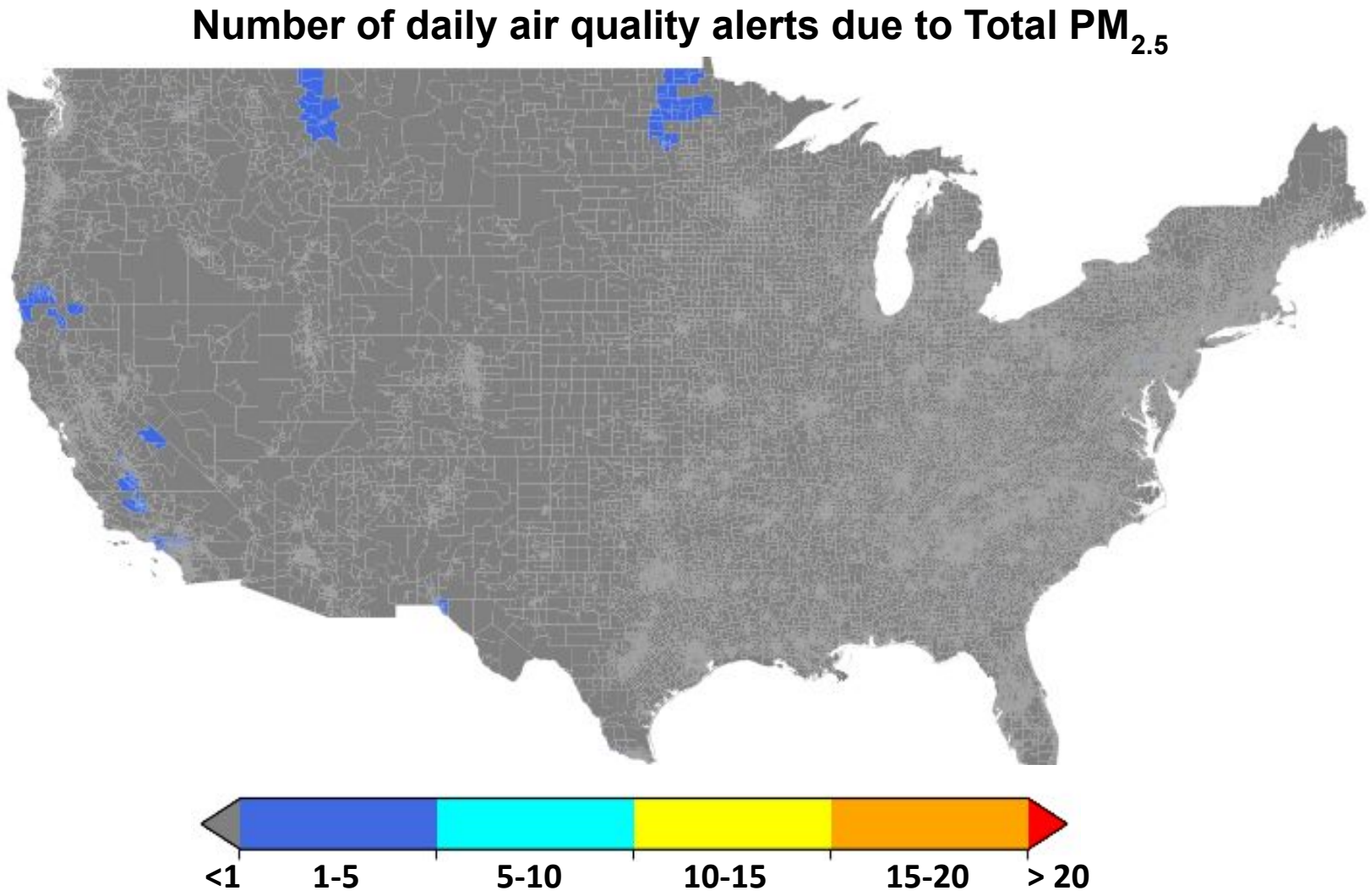
Racial/ethnic data indicates that there is some disparity in daily air quality alerts from Total $PM_{2.5}$



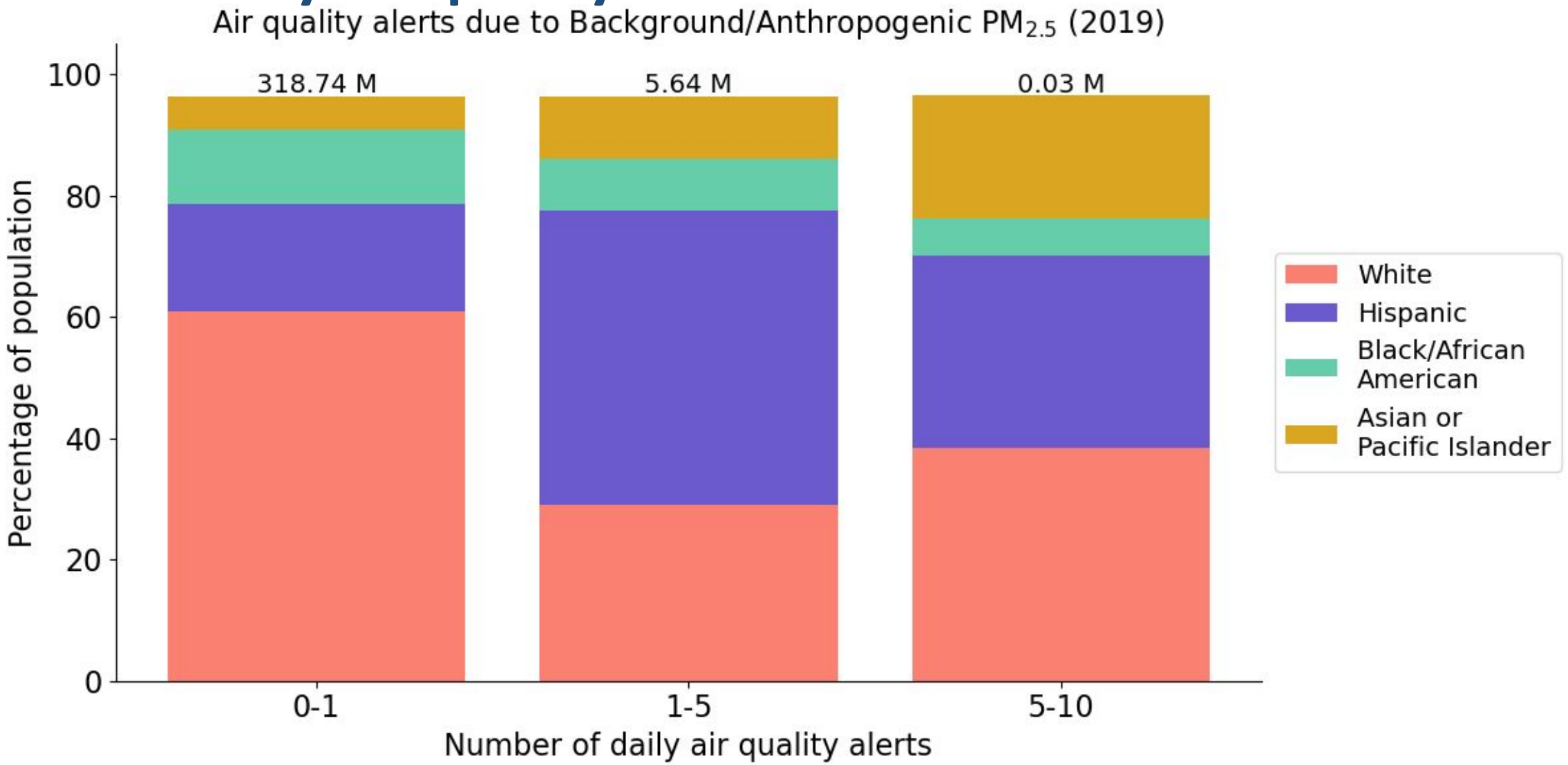
Background/anthropogenic $PM_{2.5}$ shows even larger disparities



Low-fire year (2019) shows very few daily $PM_{2.5}$ concentrations above 35.5 µg m^{-3}



Hispanics still have proportionally higher number of daily air quality alerts



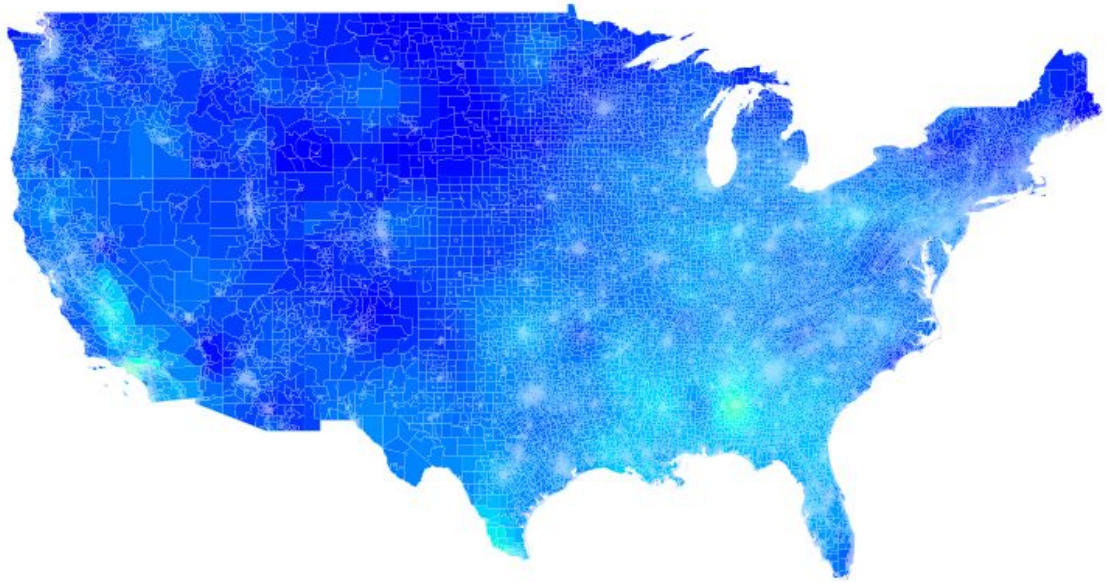
Conclusions

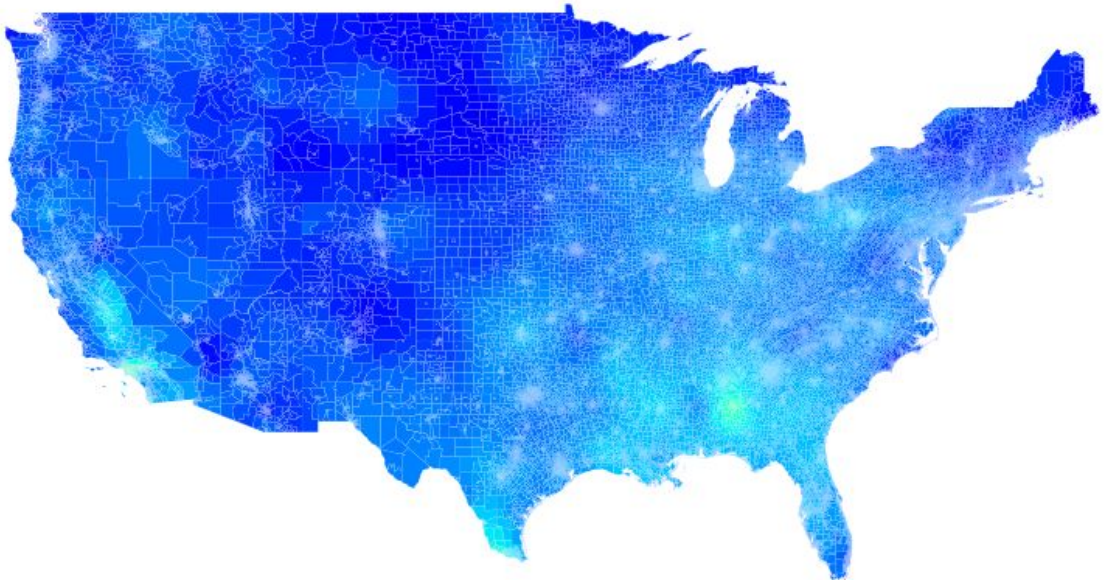
- VIIRS observations indicate a large population increase across many counties that will exceed the new annual $PM_{2.5}$ NAAQS, even in the absence of smoke/dust.
  - This would lead to a dramatic increase in the need for State Implementation Plans (SIPs)
- The increasing number landscape fires and reduced annual NAAQS may lead to a large increase in Exceptional Events Reports, which require significant man-hours and analysis to complete.
- VIIRS indicates racial/ethnic disparities in the number of daily air quality alerts ($PM_{2.5}$ > 35 µg m^{-3}) for both Total and Background/Anthropogenic $PM_{2.5}$.

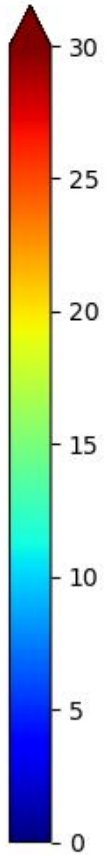
Supplemental Slides

Annual Total $PM_{2.5}$ [$\mu g\ m^{-3}$] (2019)

Annual Background/Anthropogenic $PM_{2.5}$ [$\mu g\ m^{-3}$] (2019)

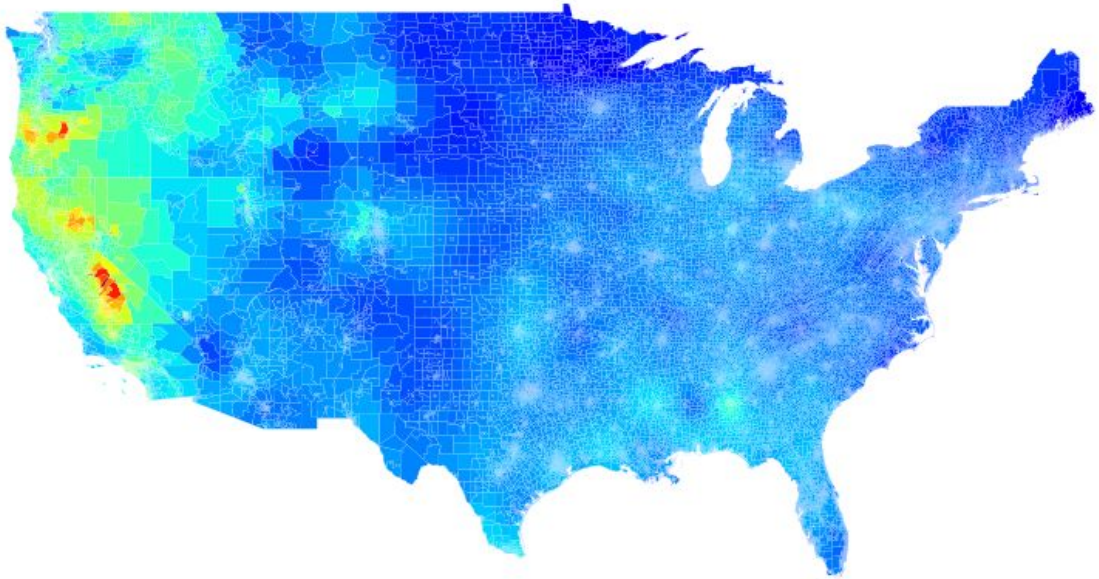


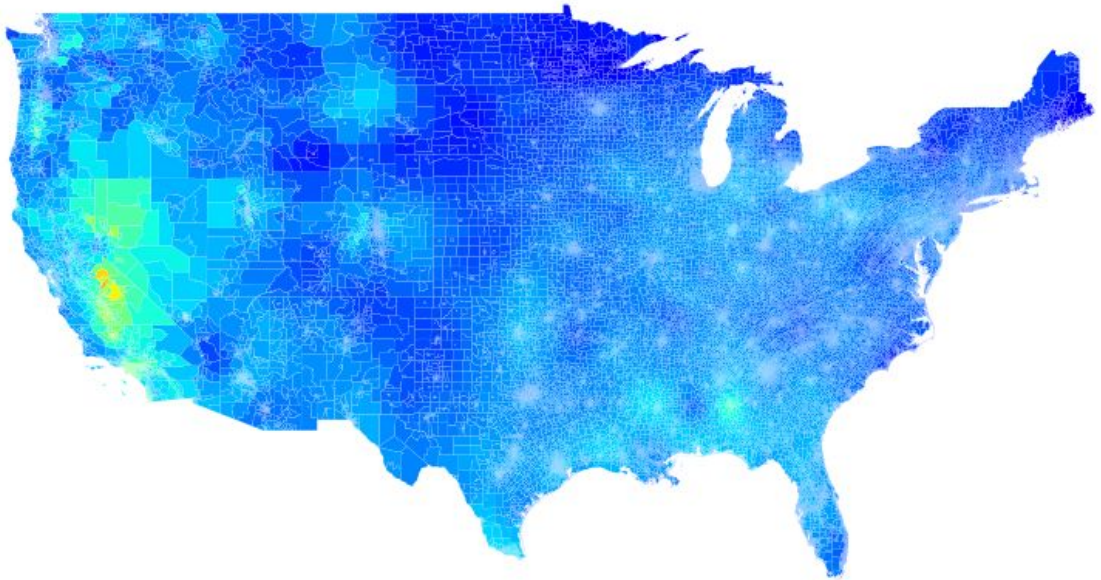




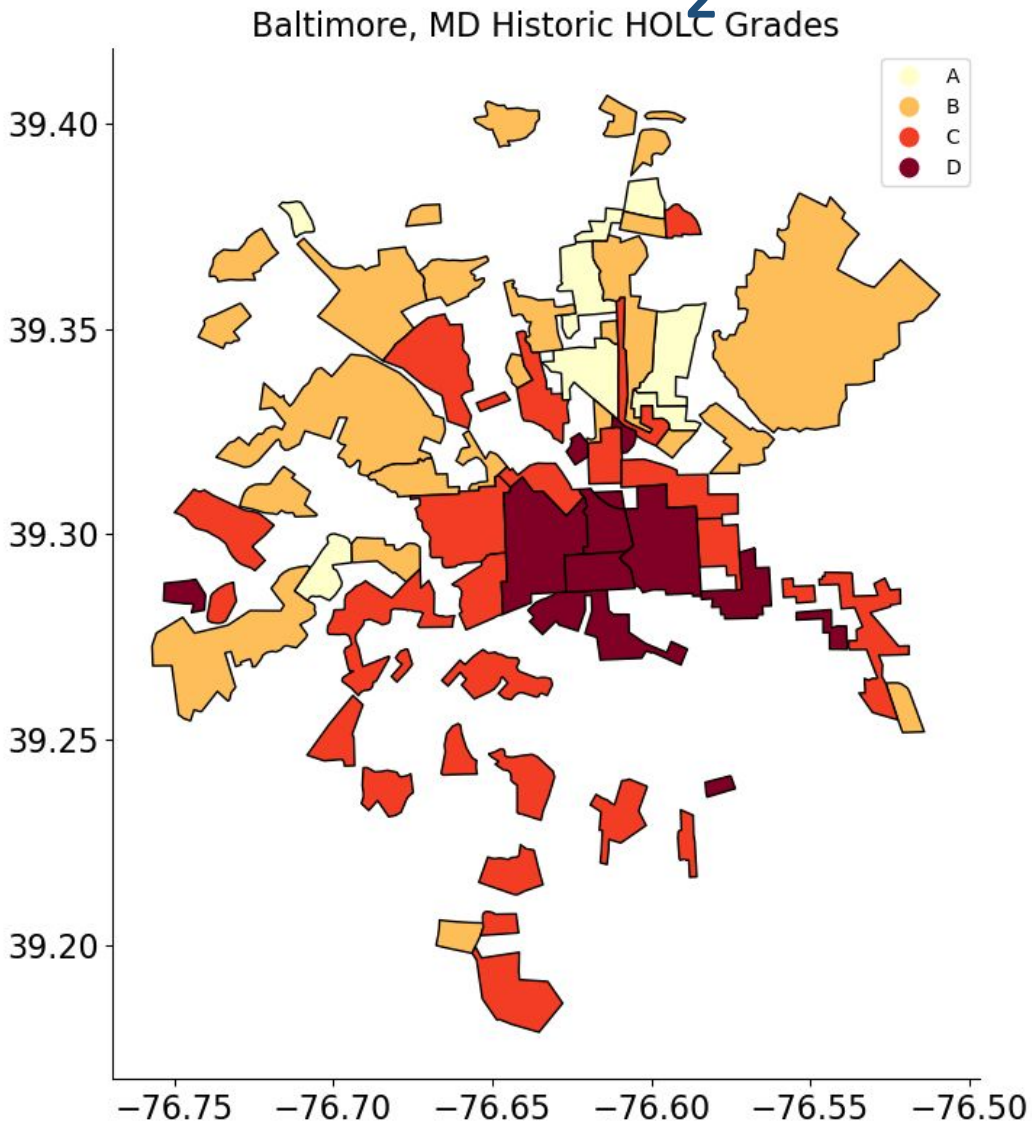
Annual Total $PM_{2.5}$ [$\mu g\ m^{-3}$] (2020)

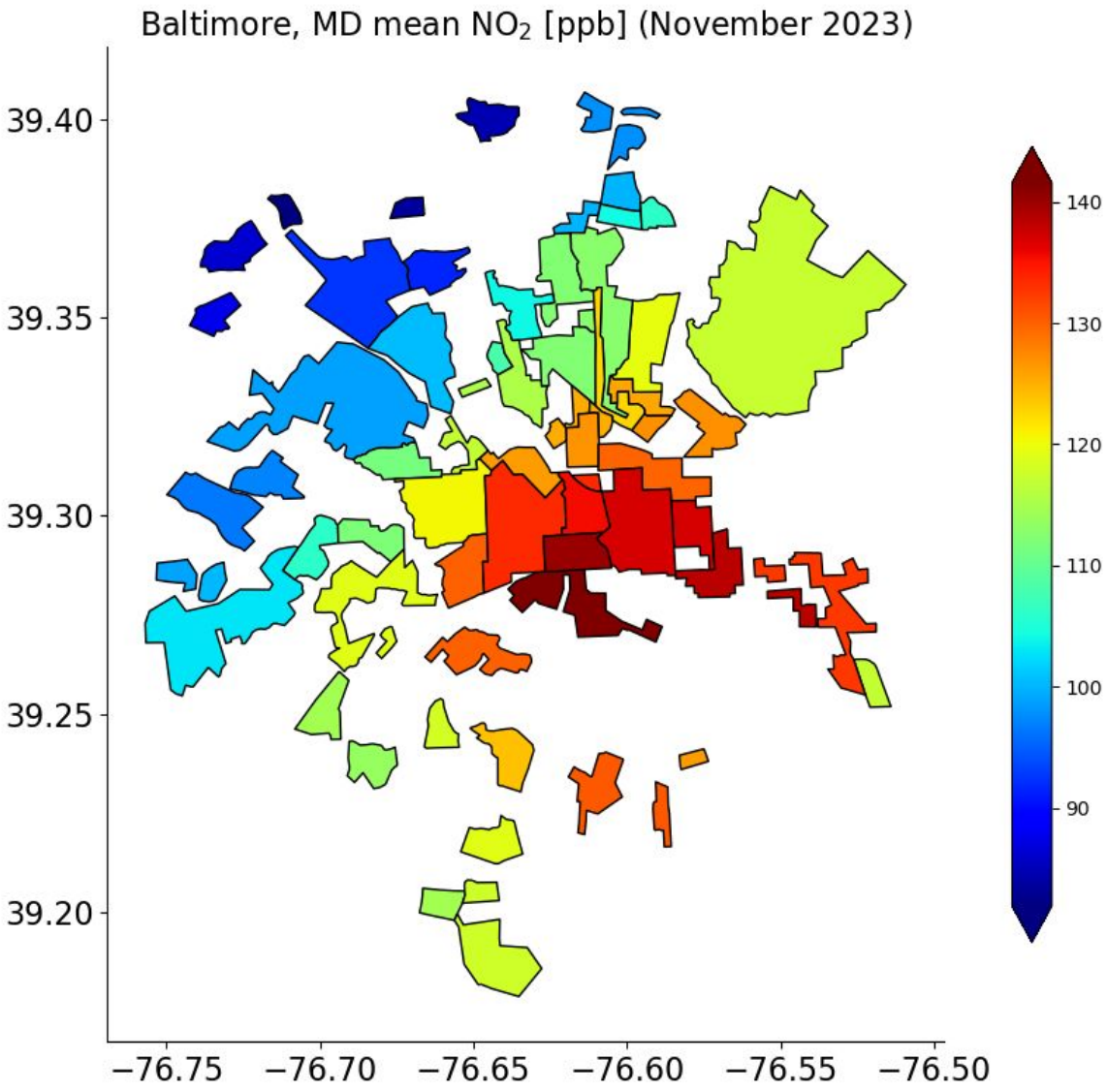
Annual Background/Anthropogenic $PM_{2.5}$ [$\mu g\ m^{-3}$] (2020)





Historically "Redlined" neighborhoods correlate with high NO_2 concentrations in Baltimore





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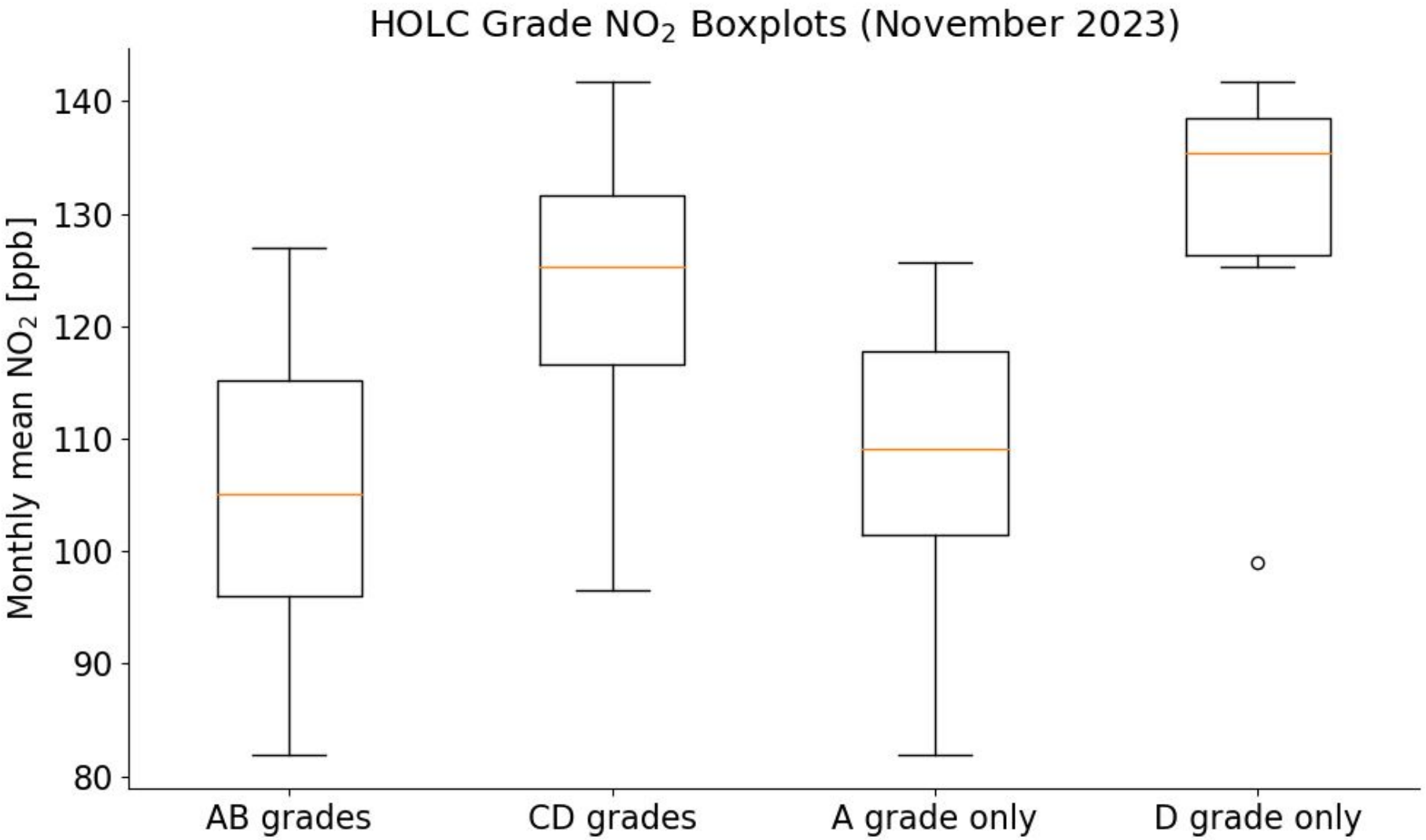
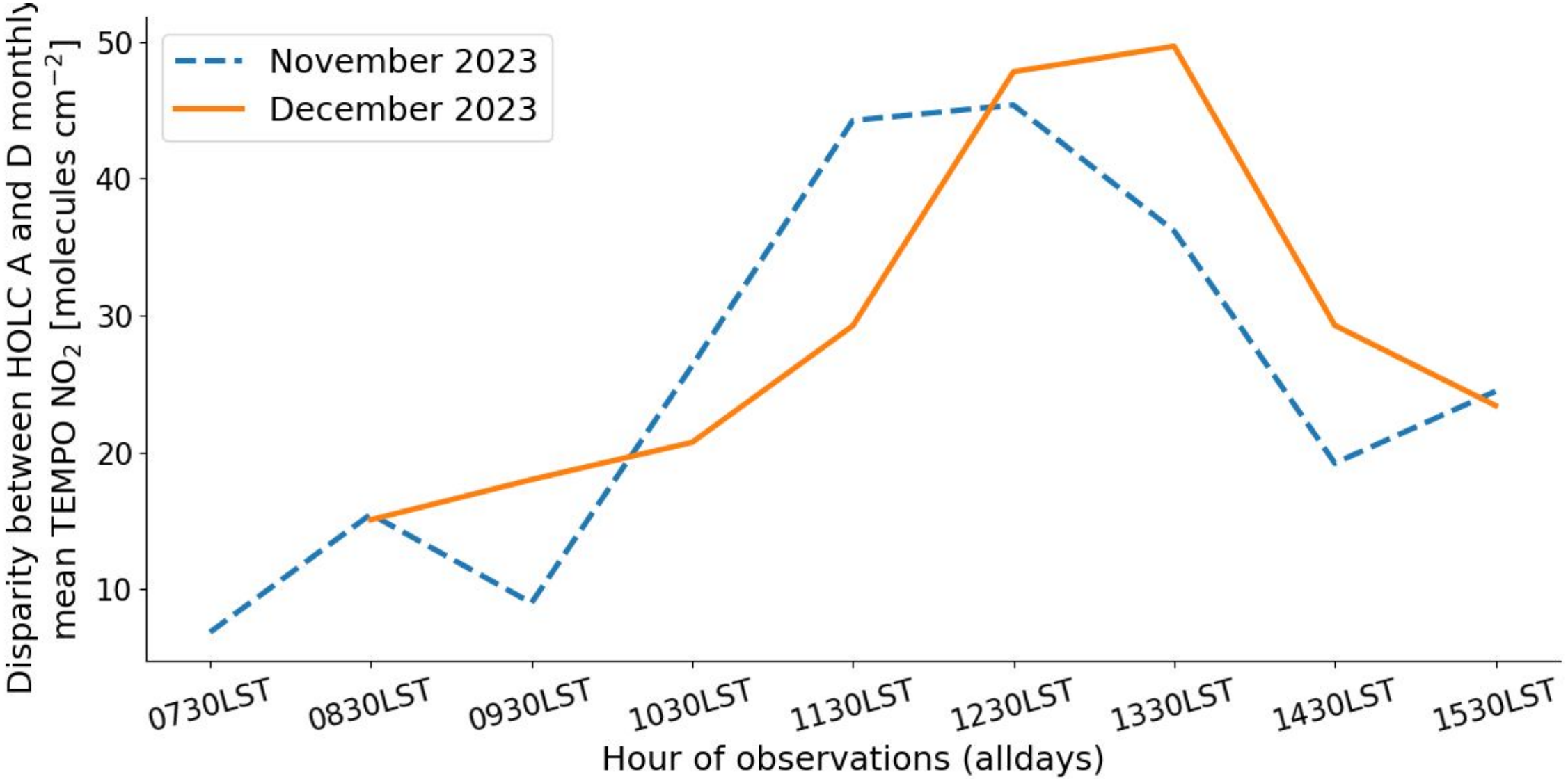
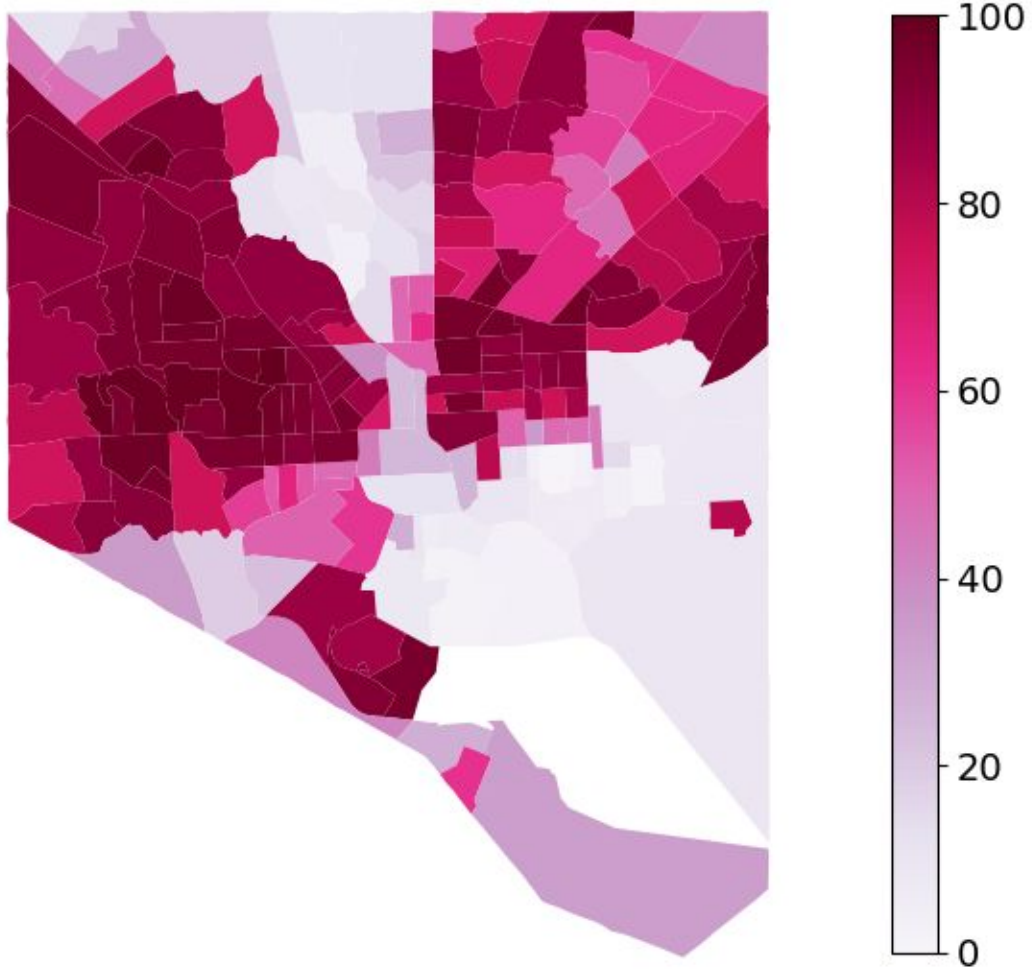


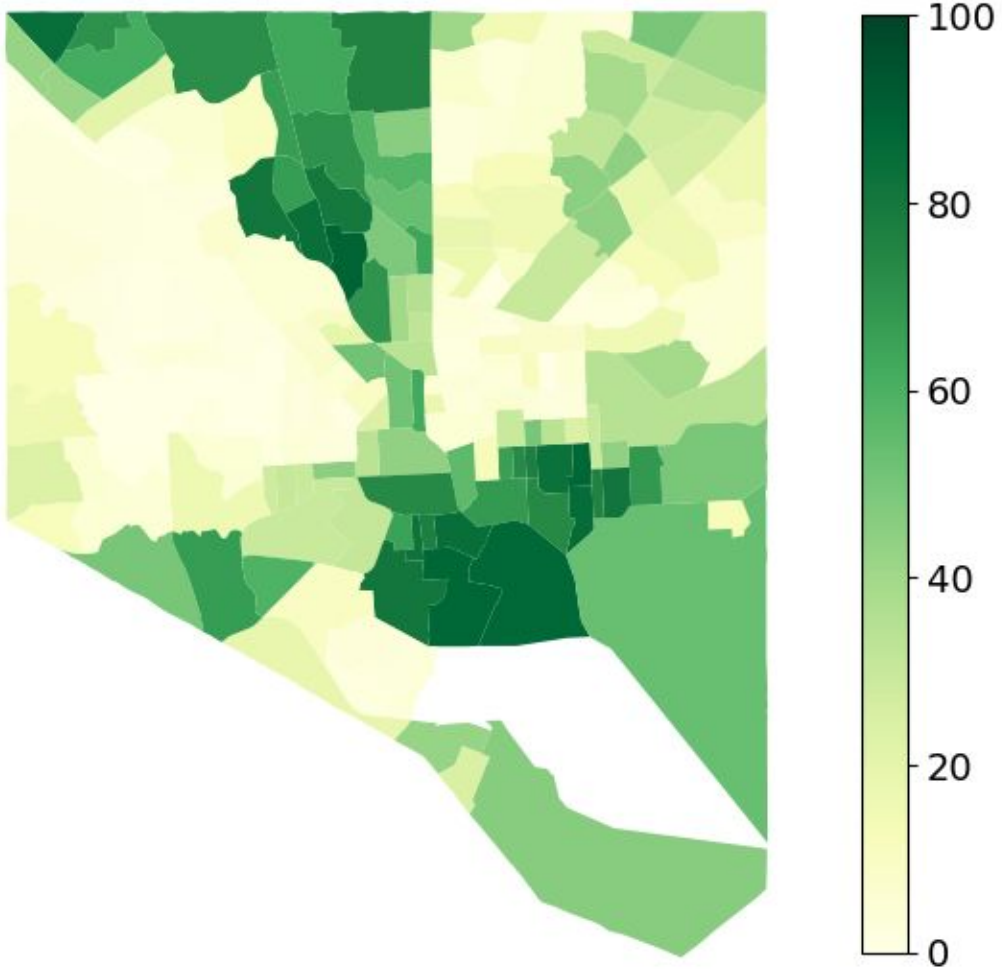

November 2023
December 2023
Disparity between HOLC A and D monthly mean TEMPO NO_2 [molecules cm^{-2}]
50
40
30
20
10
0730LST
0830LST
0930LST
1030LST
1130LST
1230LST
1330LST
1430LST
1530LST
Hour of observations (alldays)

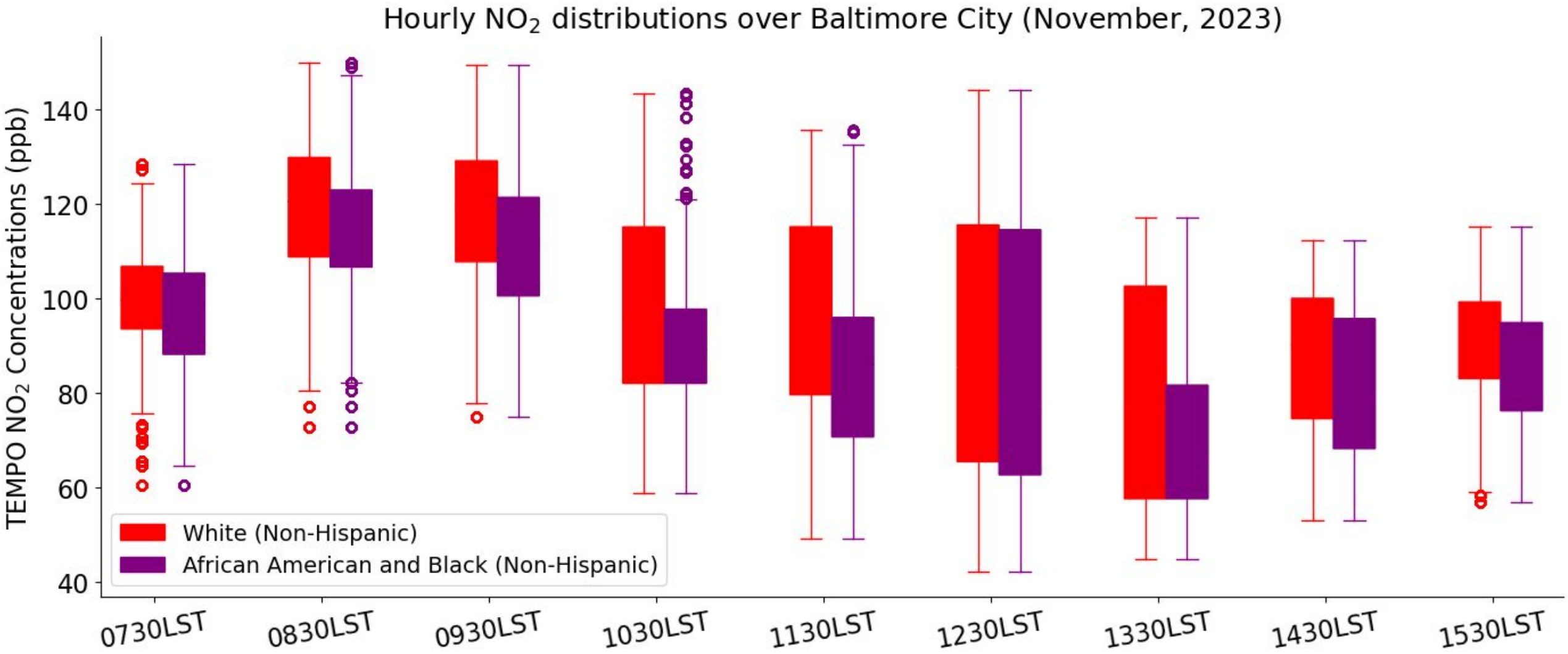
But what if we look at modern racial/ethnic patterns in Baltimore City?

Percent African American or Black (Non-Hispanic)



Percent White (Non-Hispanic)




Hourly NO_2 distributions over Baltimore City (November, 2023)
TEMPO NO_2 Concentrations (ppb)
140
120
100
80
60
40
White (Non-Hispanic)
African American and Black (Non-Hispanic)
0730LST
0830LST
0930LST
1030LST
1130LST
1230LST
1330LST
1430LST
1530LST