Daily Satellite Observations of Nitrogen Dioxide Air Pollution Inequality in the New York City-Newark Urbanized Area

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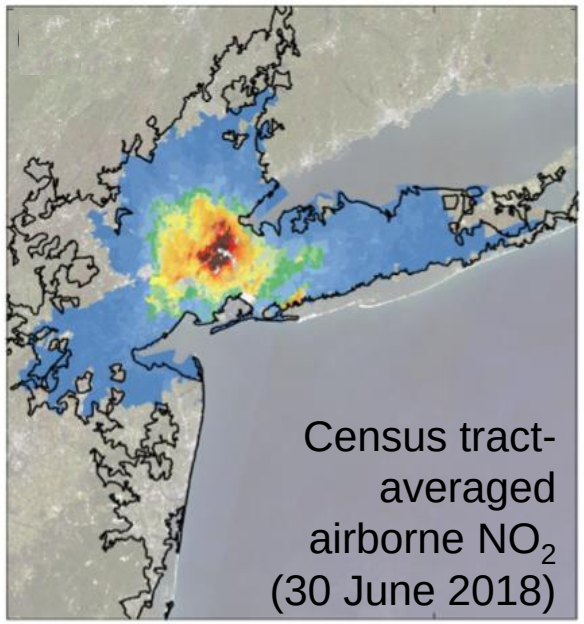

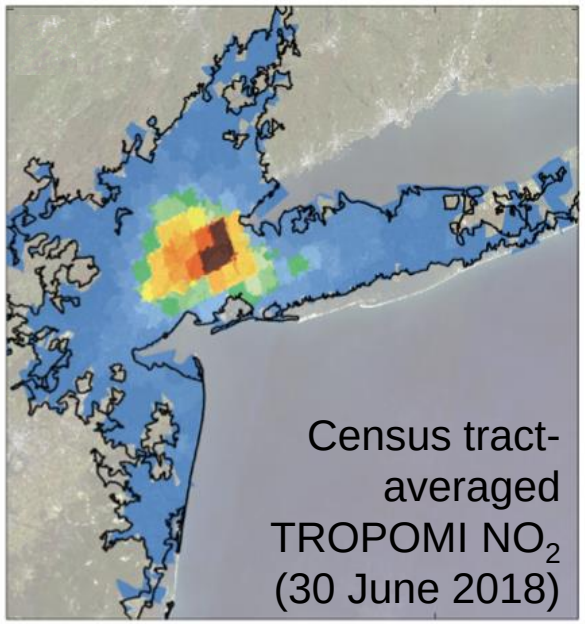

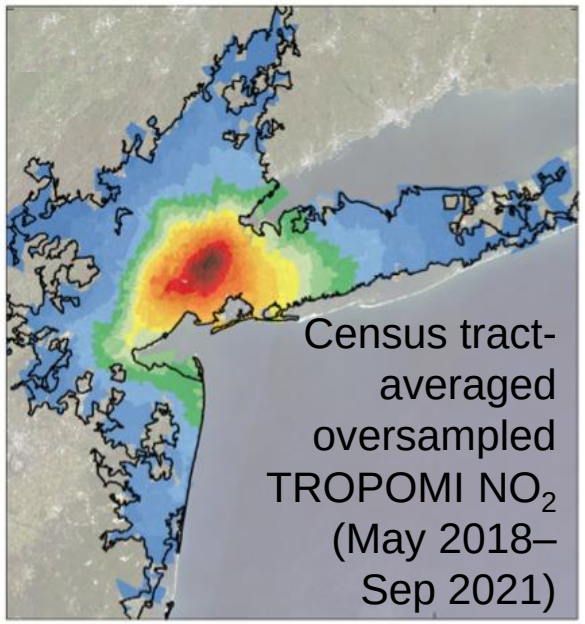

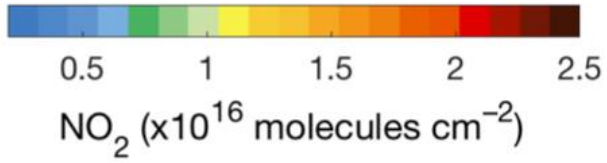

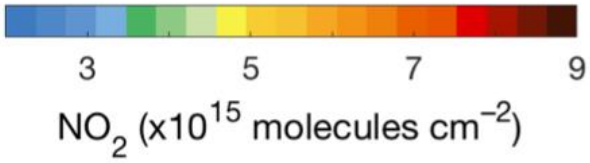

Isabella Dressel

- Can daily TROPOMI observations resolve neighborhood-level NO_2 inequalities?
- How are NO_2 inequalities situated in broader contexts of air quality and climate?

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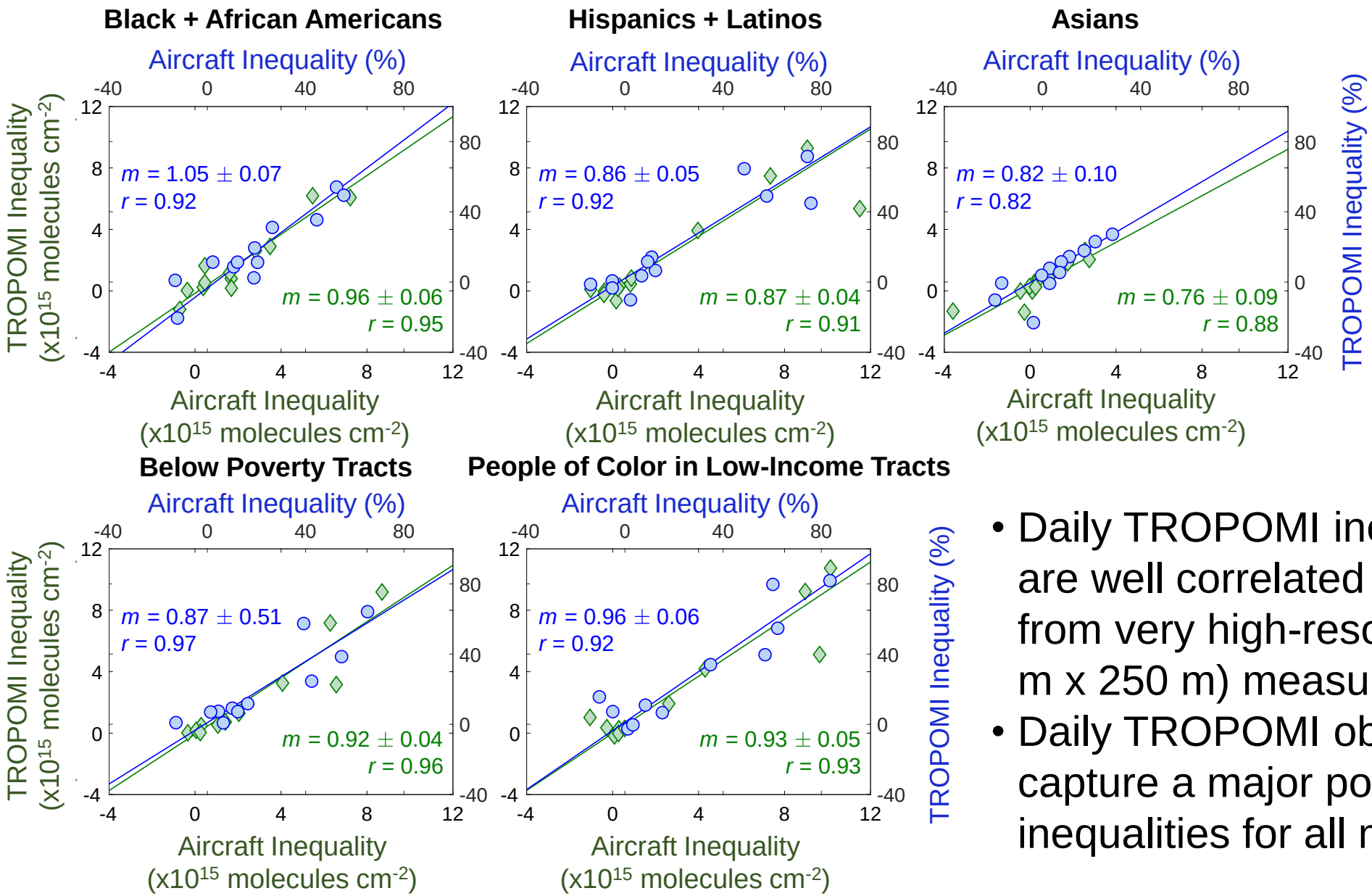
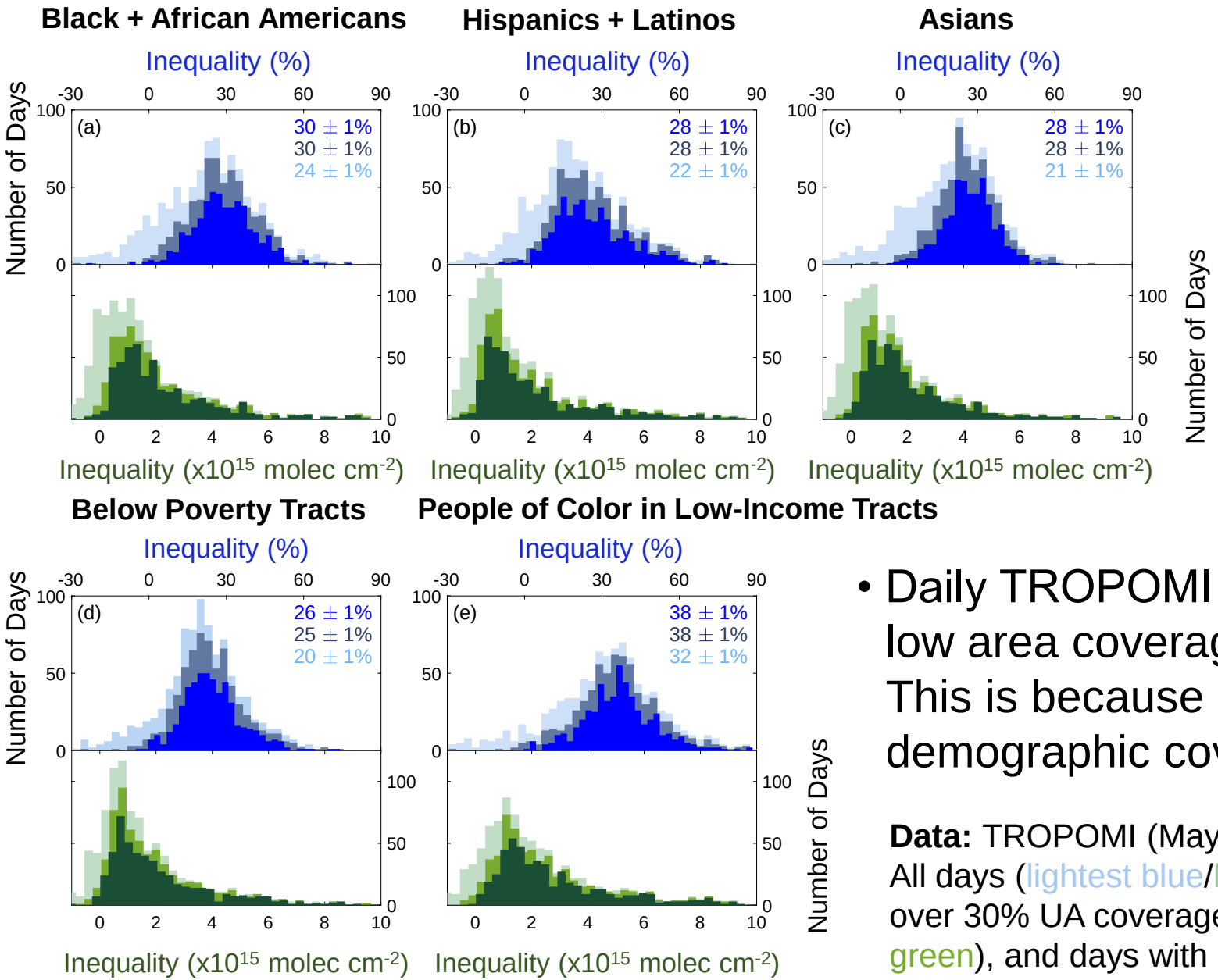
Daily TROPOMI observations resolve a majority of NO_2 disparities



- Daily TROPOMI inequalities are well correlated with those from very high-resolution (250 m x 250 m) measurements
- Daily TROPOMI observations capture a major portion of inequalities for all metrics

Data: Coincidental measurements occur within ± 30 min over a given census tract during LISTOS (June–September 2018)

Daily TROPOMI census tract-level NO_2 inequalities are sensitive to clouds



- Daily TROPOMI estimates with low area coverage are biased low. This is because of incomplete demographic coverage

Data: TROPOMI (May 2018–September 2021). All days (lightest blue/lightest green), days with over 30% UA coverage (grey blue/yellow green), and days with over 60% UA coverage (dark blue/dark green)

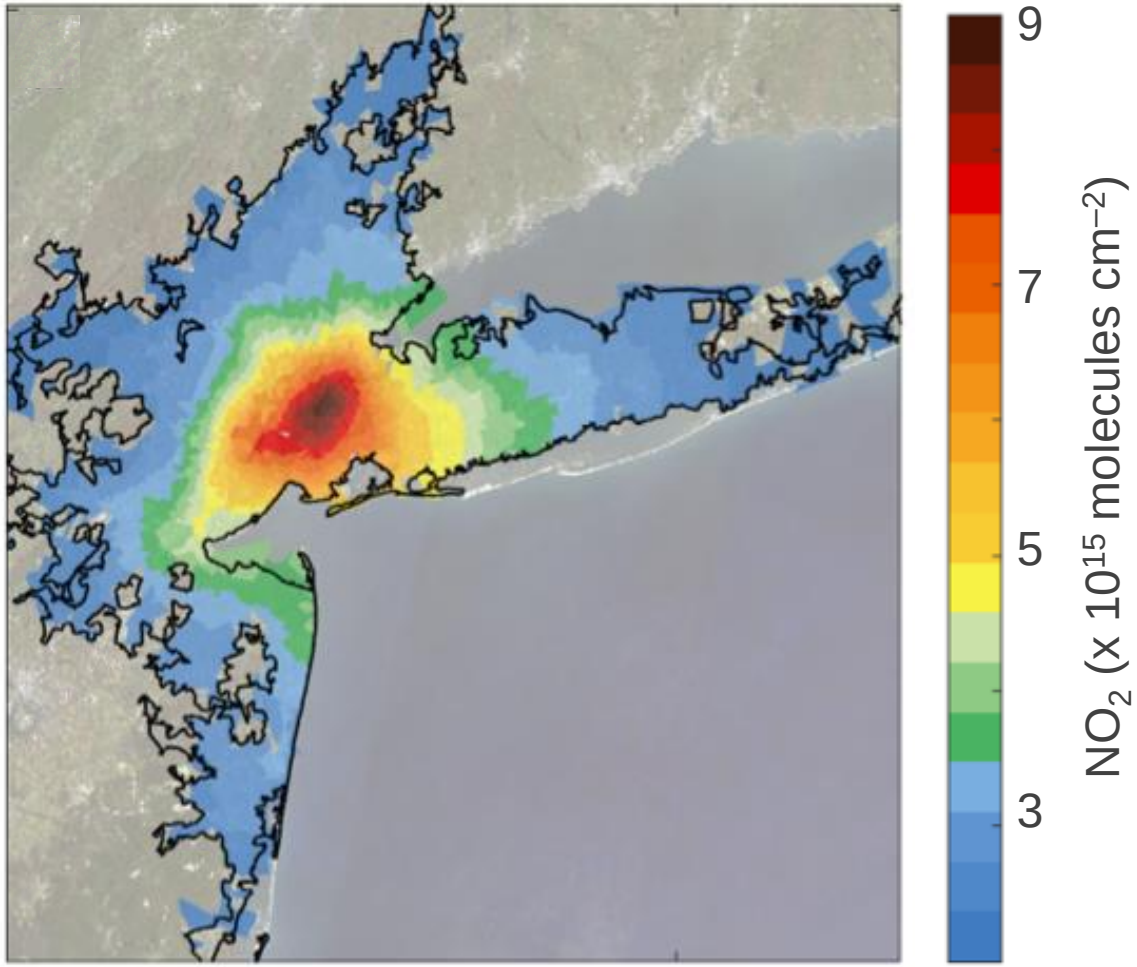
Inequalities are largely insensitive to pixel area and biased low on low-observation coverage days

	Mean of Daily Inequalities				Daily Inequalities			
	Relative Inequalities (%)				Coefficient of Variation			
Mean Pixel Area (km)	Black and African Americans	Hispanics + Latinos	Below Poverty Tracts	People of Color in Low-Income Tracts	Black and African Americans	Hispanics + Latinos	Below Poverty Tracts	People of Color in Low-Income Tracts
20–25	25 ± 2	24 ± 3	24 ± 2	33 ± 3	0.78	0.83	0.66	0.67
25–30	23 ± 3	22 ± 3	22 ± 3	31 ± 4	0.93	0.97	0.85	0.80
30–35	24 ± 3	24 ± 3	21 ± 3	32 ± 4	0.76	0.76	0.78	0.70
35–45	25 ± 3	21 ± 3	18 ± 5	32 ± 4	0.78	0.92	1.49	0.72
45–60	25 ± 3	22 ± 3	21 ± 3	34 ± 4	0.81	0.87	0.83	0.79
>60	19 ± 3	19 ± 3	19 ± 3	26 ± 4	0.91	0.97	0.81	0.86
UA Coverage (%)								
<30	12 ± 2	11 ± 2	11 ± 3	18 ± 4	1.99	2.00	2.47	1.81
30–60	30 ± 3	29 ± 3	25 ± 3	37 ± 4	0.64	0.62	0.66	0.65
>60	30 ± 1	28 ± 1	26 ± 1	38 ± 1	0.40	0.53	0.45	0.36

- Large pixel areas have a small effect on inequality estimates, with significant differences in means emerging at pixel areas of >60 km^2
- Low observation coverage affects mean daily inequalities and the daily inequalities themselves

Mean daily TROPOMI inequalities agree with estimates using observations first oversampled to 0.01º x 0.01º

New York City–Newark Urbanized Area



	Oversampled Inequality	Mean Daily Inequality
All days	36 ± 2%	32 ± 4%
>30% coverage	35 ± 2%	38 ± 3%
>60% coverage	36 ± 2%	38 ± 2%

- Daily mean inequalities equal those produced using oversampled TROPOMI (0.01º x 0.01º) using high coverage observations

Data: TROPOMI observations from May 2018–September 2021 oversampled to 1 km x 1km

Situating NO_2 inequalities in an urban air quality context

	Absolute Inequality			Relative Inequality	
Summer					
	Surface NO_2*	NO_2 TVCDs	MD8A O_3	Surface NO_2*	NO_2 TVCDs
Black and African Americans	0.54	0.59	0.41	0.19	–
Hispanics and Latinos	0.68	0.71	0.50	0.47	0.39
Below Poverty Tracts	0.67	0.67	0.46	0.34	0.18
People of Color in Low-Income Tracts	0.64	0.66	0.45	0.37	0.24
Winter					
	Surface NO_2*	NO_2 TVCDs		Surface NO_2*	NO_2 TVCDs
Black and African Americans	0.68	0.68		–	–
Hispanics and Latinos	0.72	0.68		0.45	0.28
Below Poverty Tracts	0.70	0.60		–	–
People of Color in Low-Income Tracts	0.75	0.68		–	–

- Communities of color are overburdened by pollution sources, incremental NO_x reductions will not eliminate NO_2 disparities
- Targeted NO_x control in environmental justice communities will improve city-wide ozone

Current inequalities will likely worsen with climate change

Summer Inequalities			
	Surface Wind Speeds	Surface Temperatures	Daily Maximum Temperature
Black and African Americans	–0.25	–	0.19
Hispanics and Latinos	–0.50	0.28	0.33
Below Poverty Tracts	–0.39	0.21	0.27
People of Color in Low-Income Tracts	–0.40	0.24	0.30

Winter Inequalities		
	Surface Wind Speeds	Surface Temperatures
Black and African Americans	–0.61	–0.44
Hispanics and Latinos	–0.65	–0.31
Below Poverty Tracts	–0.58	–0.37
People of Color in Low-Income Tracts	–0.63	–0.40

- Higher inequalities with lower wind speeds — more frequent stagnation days (summer + winter) are predicted in the future
- In the summer, NO_2 inequalities are weakly related to surface temperatures — more hot days will increase cumulative burdens on communities with environmental justice concerns

Data: Spearman rank correlation coefficients between inequalities and UA-mean surface meteorology on days with >60% coverage