

The Climate and Environmental Justice Implications of Reducing Diesel Truck Emissions

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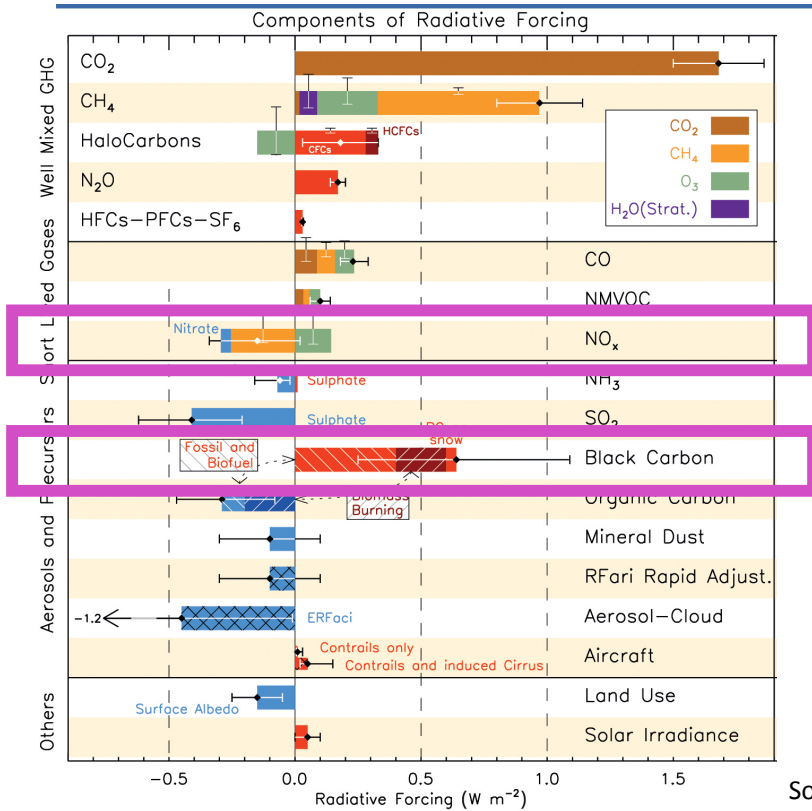
Background: Local Impact



Source: SFGate

- Heavy-duty diesel trucks are dominant mode of freight transport activity
- Major sources of NO_x and PM
 - The majority of diesel PM mass emissions is BC
 - Exposure has been associated with many adverse health effects
- Highly-localized air pollution and health impacts from heavy-duty diesel exhaust

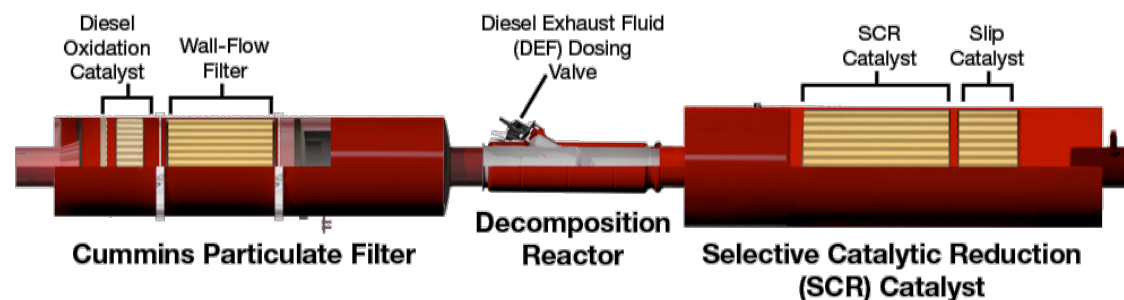
Background: Regional Impact



Source: IPCC

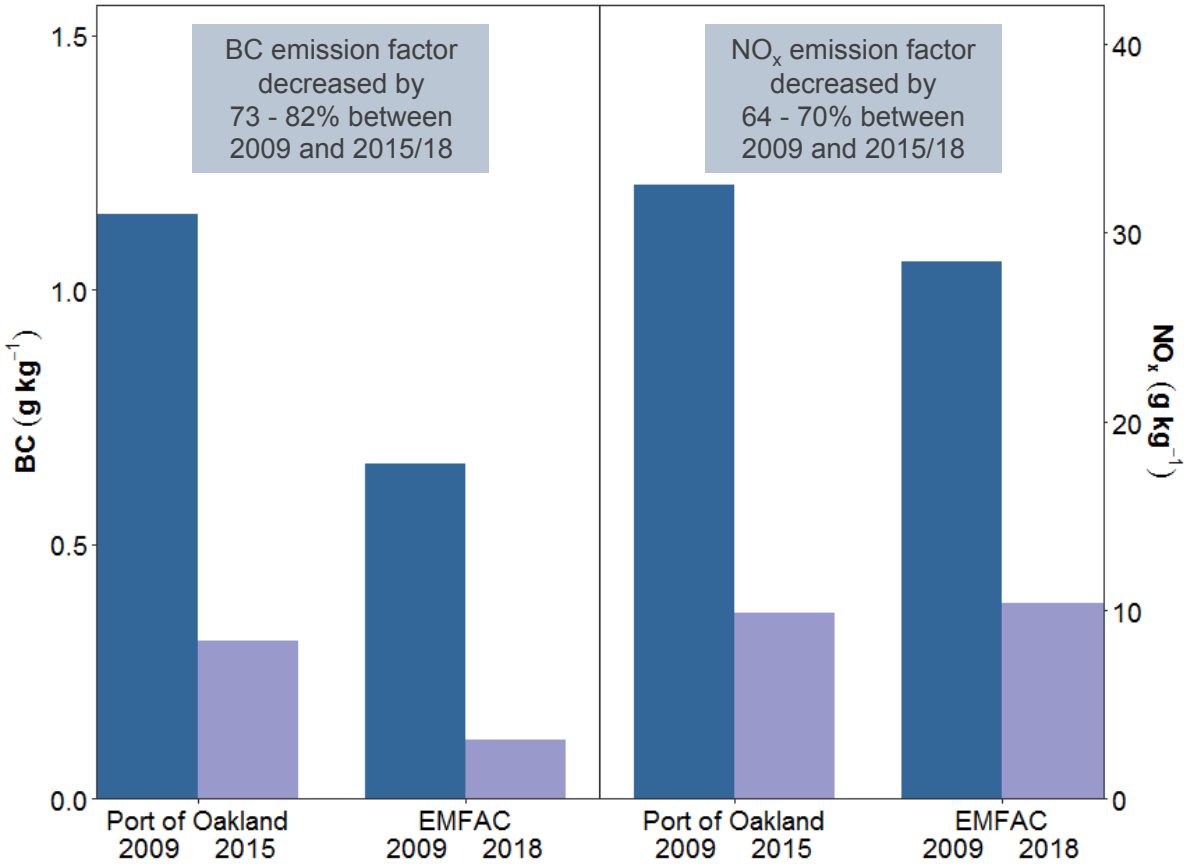
- NO_x is a precursor in the formation of tropospheric ozone, a greenhouse gas
- BC is a short-lived climate-forcing pollutant

Diesel Emission Controls



- National emission standards require 98% control of PM and NO_x relative to uncontrolled engines
- Exhaust after-treatment control technologies:
 - Diesel particle filters (DPFs) for PM control (2007+ MY)
 - Selective catalytic reduction (SCR) systems for NO_x control (2010+ MY)
- CA rules require all heavy-duty diesel engines have DPFs by 2018

Rapid Emission Reductions Achieved in CA

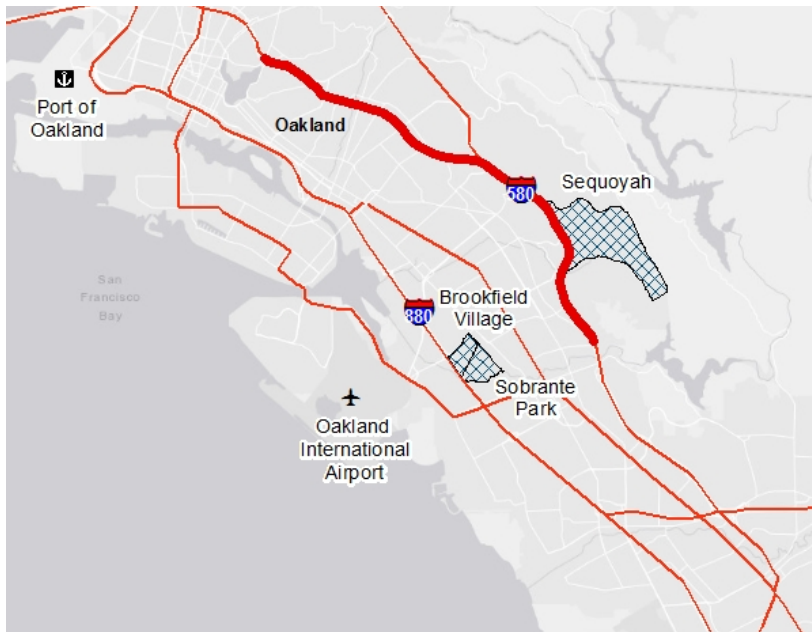


Sources: EMFAC 2017 model; Preble et al., 2018

Study Motivation

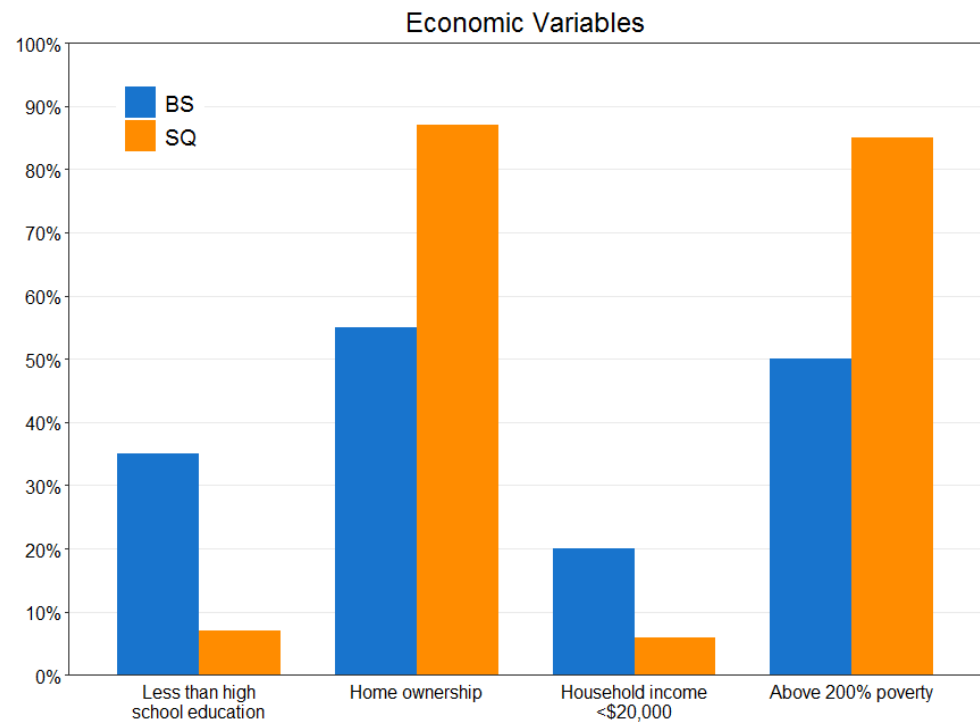
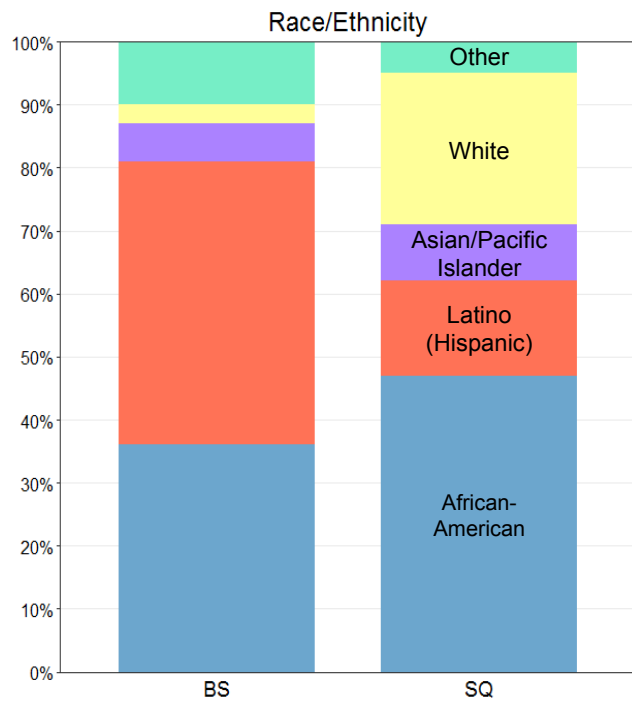
- No analysis of impacts on environmental equity and justice
- Definitions:
 - **Environmental equity**: the equal distribution of environmental risks across the *total population*
 - **Environmental justice**: the distribution of risk burden *between population groups*, including racial, ethnic, or socioeconomic groups

Study Area: East Oakland Freight Corridor



- I-880
 - Carries highest volume of trucks in the region
- I-580
 - No trucks over 4.5 tons along segment indicated by **thick red line**
 - The *only* Interstate Freeway not open to trucks
- All truck traffic, including Port- and airport-related cargo movement, must travel on I-880

Demographic Variables in Each Receptor Area

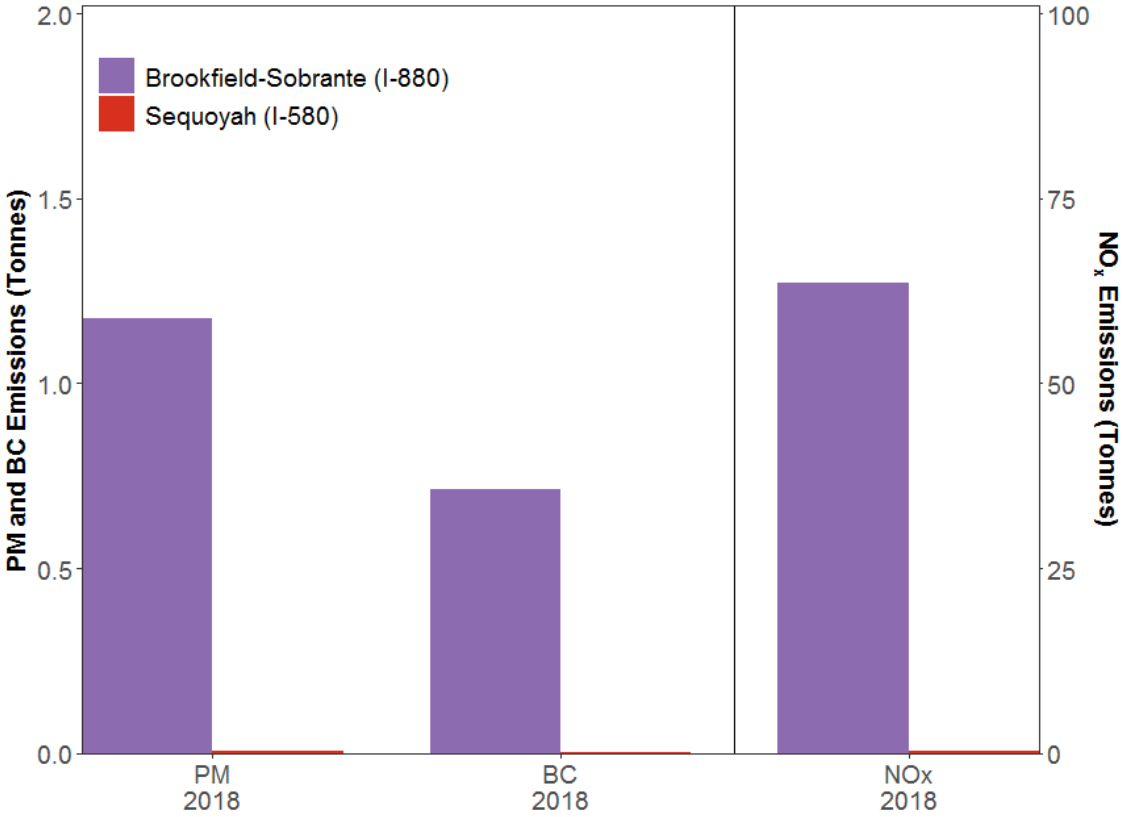


Methods

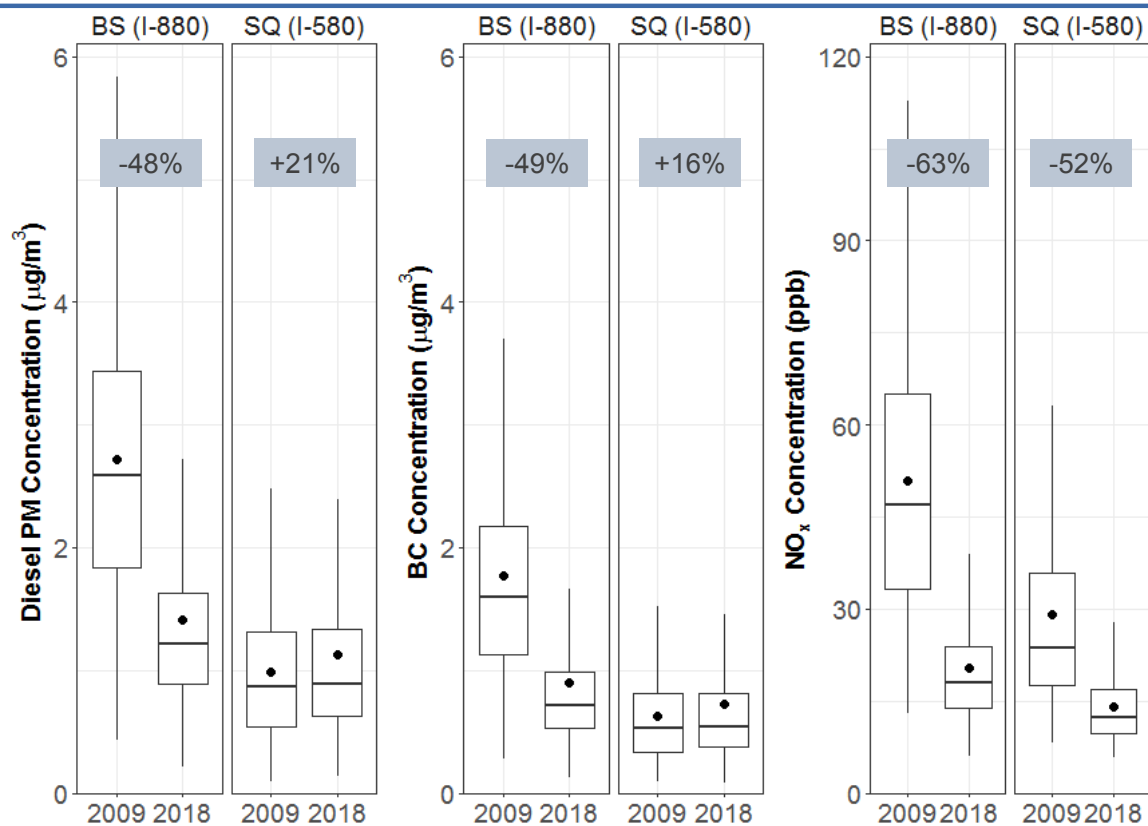
Study Years: 2009 (pre-policy) and 2018 (post-policy)

1. Estimated change in diesel PM, BC, and NO_x emissions
 - Used bottom-up approach to estimate link-based emissions for the modeled road network
2. Modeled change in concentrations
 - Predicted near-roadway concentrations at Census-block centroids within 100 m of freeway using the RLINE line-source dispersion model
 - Assigned all individuals within Census-block to the concentration estimated at the centroid
3. Estimated changes in metrics of equity and justice
 - Used the Atkinson Index (equality) and Relative Percent Difference (justice)

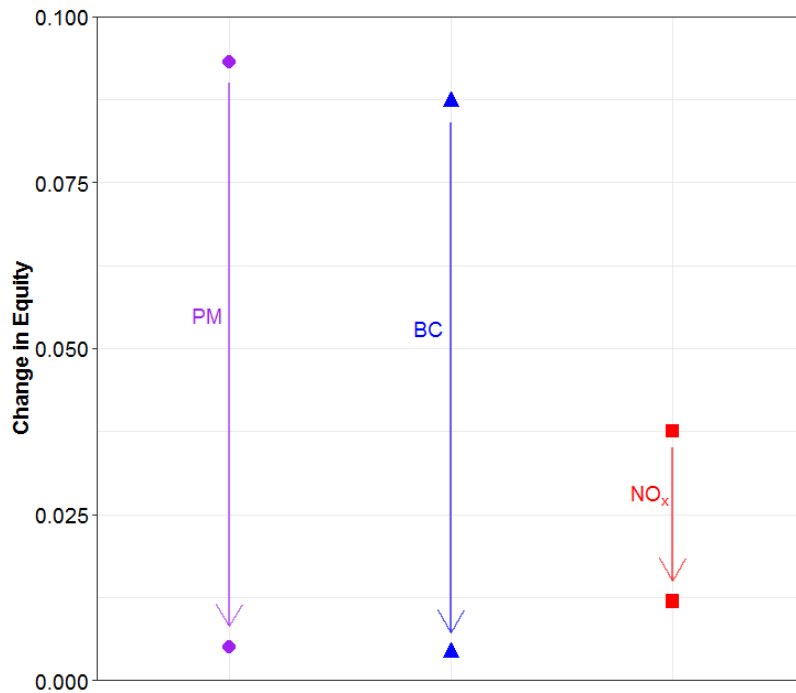
I-880 v I-580 Heavy-Duty Truck Emissions



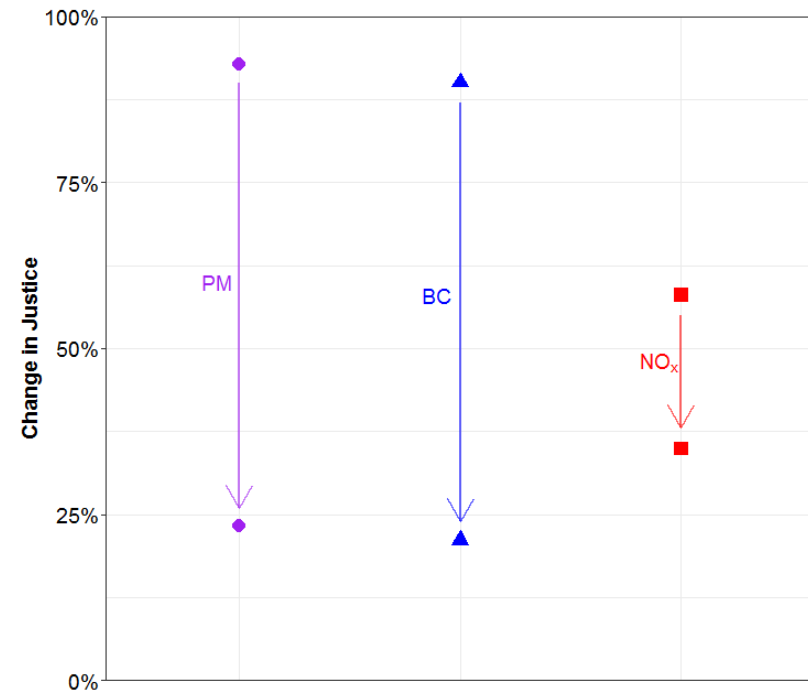
Reductions in Pollutant Concentrations



Changes in Metrics of Equity and Justice, 2009 → 2018



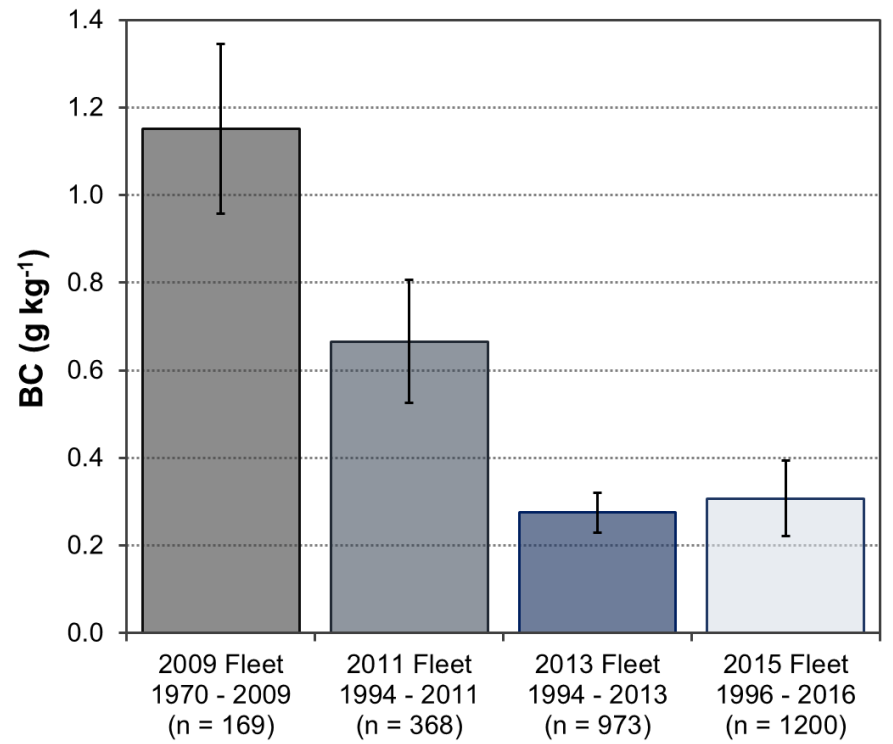
Atkinson Index: quantifies equality in exposure for all individuals



Relative Percent Difference (%): quantifies difference in exposures among groups

Discussion

- Decrease in diesel truck emissions from current controls outpaced increased truck volumes and contributed to the trend of decreasing concentrations
- The equity and justice benefits of diesel truck control efforts rely on proper functioning of exhaust after-treatment control systems



Source: Preble et al., ES&T 2018

Summary

- Heavy-duty truck emissions are much higher on I-880 than on I-580
- Larger reductions in diesel PM, BC, and NO_x concentrations on I-880, yet still higher than concentrations on I-580
 - Diesel PM, BC, and NO_x concentrations reduced by 48%, 49%, and 63%
- Narrowed gap by cleaning up emissions, however additional diesel controls necessary to achieve equity and justice
 - RPD reduced by 70% for diesel PM, 69% for BC, and 23% for NO_x