Criteria Pollution Data Analysis on NYC's Clean Heat Program

Danny R | Columbia University

Luke S | Columbia LDEO , Harvard University

Roisin C | Columbia University LDEO

Introduction

Over time, anthropogenic activity has compounded pollution production, climate issues, and health hazards, especially in New York City (NYC). Over a decade ago, the NYC mayor's office identified their lack of control over the city's pollution and their subsequent failure to maintain adequate Clean Air Act standards. NYC's long-term goal is to be the cleanest US city by 2030. To achieve this, new policy regulations, beyond the federal Clean Air Act, have been implemented.

The NYC Clean Heat Program, a citywide regulation, specifically targets the largest pollution producers in NYC. The regulation banned the burning of the dirtiest fuel oils used in NYC to heat commercial and residential buildings. The regulation, implemented in April 2011, has two deadlines, July 2015 and January 2030. Fuel oils are labeled, #6 and #4. As of 2015 Fuel oil #6 has been banned. Fuel oil #4 is legal until 2030. I'm curious whether the Clean Heat Program affected air quality. I believe the ban on dirty fuels had a significant effect on pollution concentrations.

I want to explore whether the Clean Heat Program was effective at targeting the specific sources of pollution. What changes, if any, has it made? Is there anything preventing it from being more successful? What could be done more efficiently? Is it making NYC safer for individuals?

From this perspective, it is imperative, to analyze air pollution datasets by extracting concentration values and modelling them over time. The motivation is to provide legitimate data analysis regarding pollution that directly affects human lives and the health of the environment.

Methods

I organized my approach into three categories: Dataset collection, programming, and analysis of models.

- **Collection:** Source two decades of daily datasets from EPA across NYC and NJ

- **Programming:** Python to organize datasets, plot values, and model the values to illustrate trends and relationships using linear regressions

- **Analysis:** Observe models and develop conclusions between datasets by comparing values before and after the policy regulation in NYC and NJ.

Results and Discussion

The primary plot analyzed for this research is illustrated below and models the NYC Sulfur Dioxide concentration from Jan 2000 – Jan 2022. The target criteria pollutant tracked was Sulfur Dioxide (SO2) due to it being the immediate byproduct of dirty heavy fuel oil burning.

The models were split into three timeline sections related to the Clean Heat Programs regulation dates. Pre policy regulation from 2000 - 2011, Policy start day for fuel oil #6 ban from 2012 – 2015, and fuel oil #6 policy regulation ban from 2016 to present.

The linear regressions models indicate a drop in SO2 over each period of the policy regulation, with a "Decreasing" return value. The models indicate a greater rate of change in NYC than in NJ. The pre-policy regulation mean concentration is 22.5 ppb. The policy regulation start to deadline concentration was 6ppb. The post #6 fuel oil ban through to the present has a concentration of 1.8 ppb.

The datasets constituted daily values from multiple locations in NYC. The highest values for each day were kept to show what the potential highest value is within certain neighborhoods. Though fuel oil #6 is illegal, fuel oil #4 is legal until 2030. Many NYC buildings converted their boilers from burning fuel oil #6 to fuel oil #4 instead of cleaner options due to the price of conversion. It is important to note fuel oil #4 is a 50/50 mixture of fuel oil #6 and a much cleaner fuel oil #2.

I believe the numbers would be lower if conversions were limited to cleaner options. Regardless, the final results indicate that the Clean Heat Programs curbed pollution in NYC and will provide cleaner air to protect the health of people and the environment.

Daily: SO_2 Sulfur Dioxide Concentration (ppb)
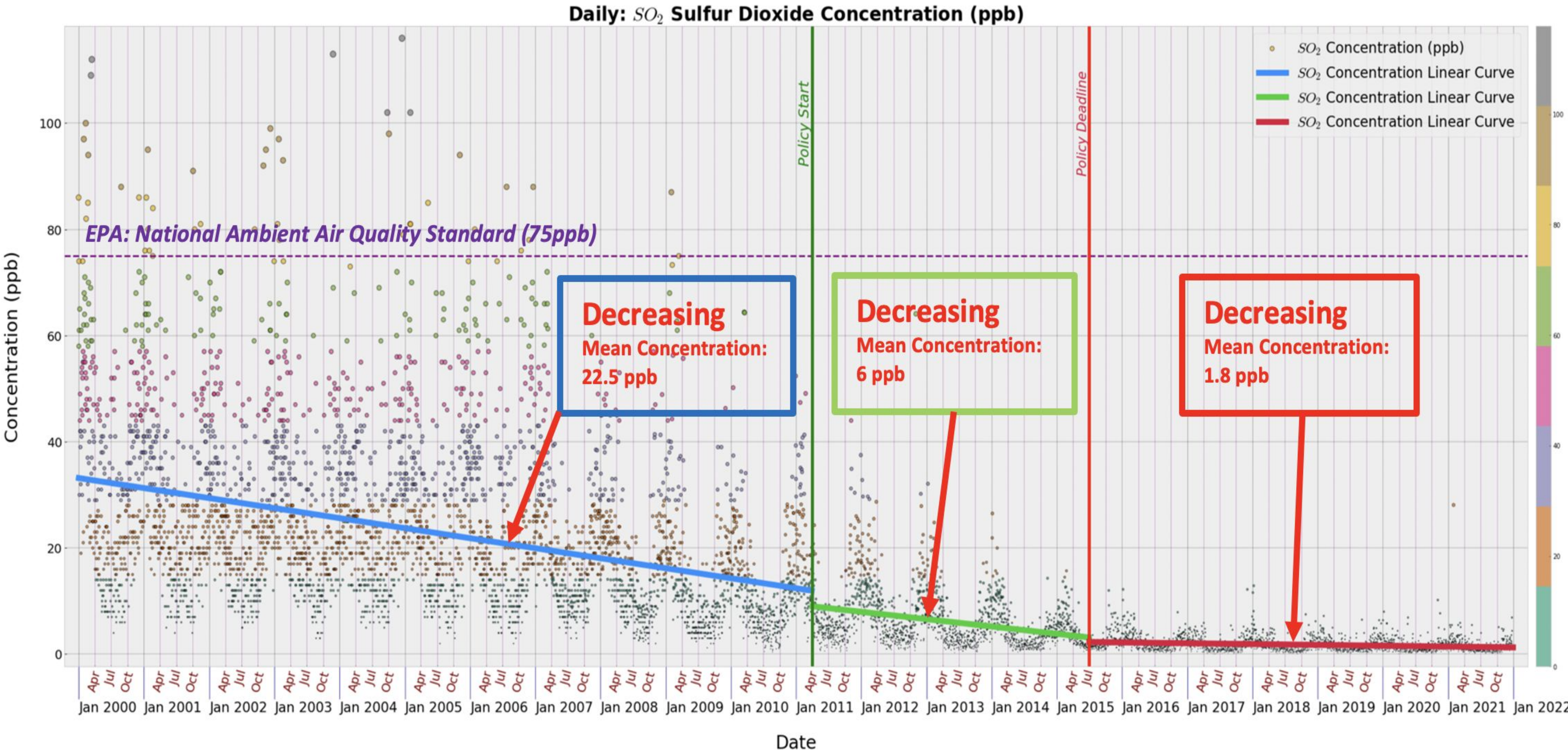
References   Hand, J.L. et al., 2012, Seasonal Compositions of Remote and Urban Fine Particulate Matter in the Unites States, Journal of Geophysical Research, vol. 117, 13 March 2012.

Carrión, Daniel et al. "Residual Inequity: Assessing the Unintended Consequences of New York City's Clean Heat Transition." *International journal of environmental research and public health* vol. 15,1 117. 11 Jan. 2018, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5800216

Environmental Protection Agency, Particulate Matter (PM) Pollution: https://www.epa.gov/pollution (accessed April 2021).