

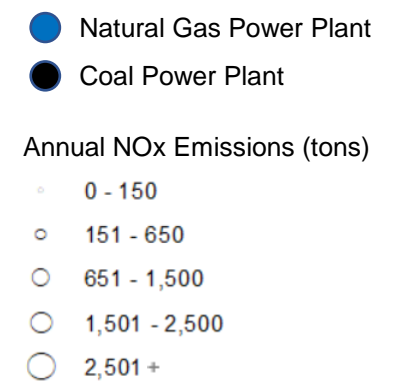
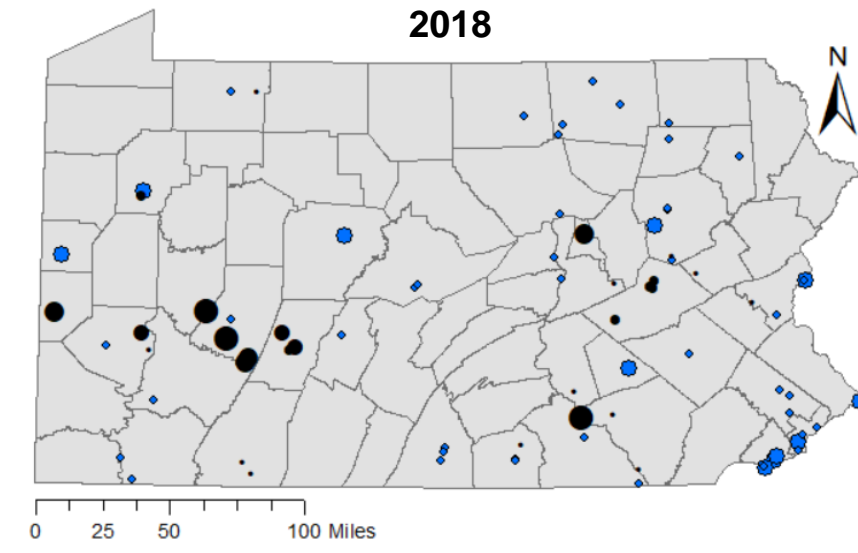
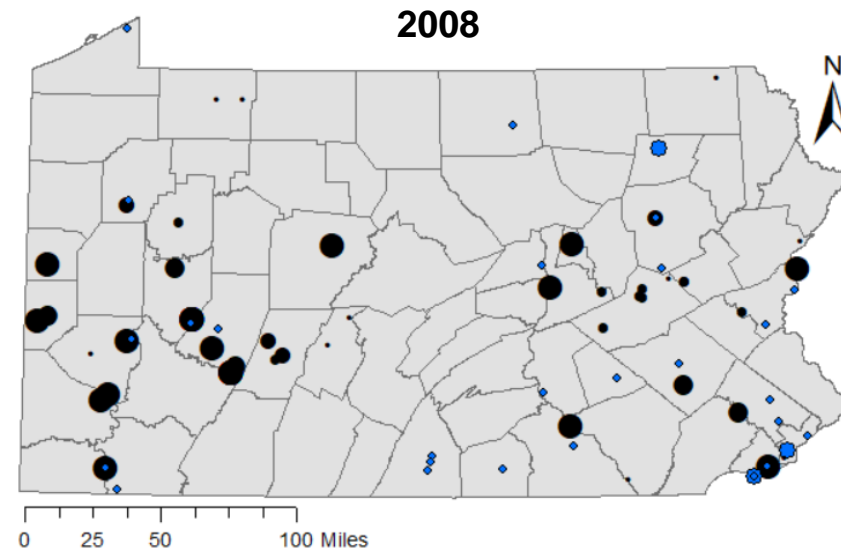
Ozone Pollution in Pennsylvania: Are Natural Gas Producing Counties Sharing in the Air Quality Benefits of Increased Natural Gas-Fired Power Generation?

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Introduction

Advances in hydraulic fracturing and horizontal drilling have led to significant increases in natural gas production in Pennsylvania over the last decade. This has led to low natural gas prices which have in turn contributed to natural gas-fired power generation displacing coal-fired generation across the state. Because natural gas combustion generates fewer pollutants than coal combustion, electric-sector emissions have declined. However, natural gas production itself generates emissions from engine exhaust and gas leakage and flaring. Compared to widely dispersed electric sector emissions, emissions from gas production are highly localized.

This project explores the relationship between changes in emissions between 2008 and 2018 and natural gas production location. It seeks to determine if the emissions reductions brought by increased natural gas use for power generation are shared equally across gas producing and non-producing regions or if emissions from gas production are offsetting these benefits.

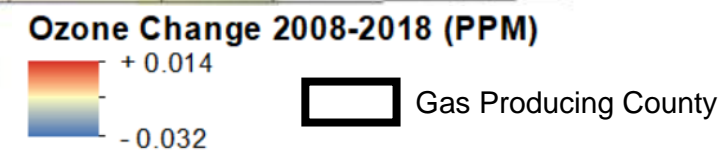
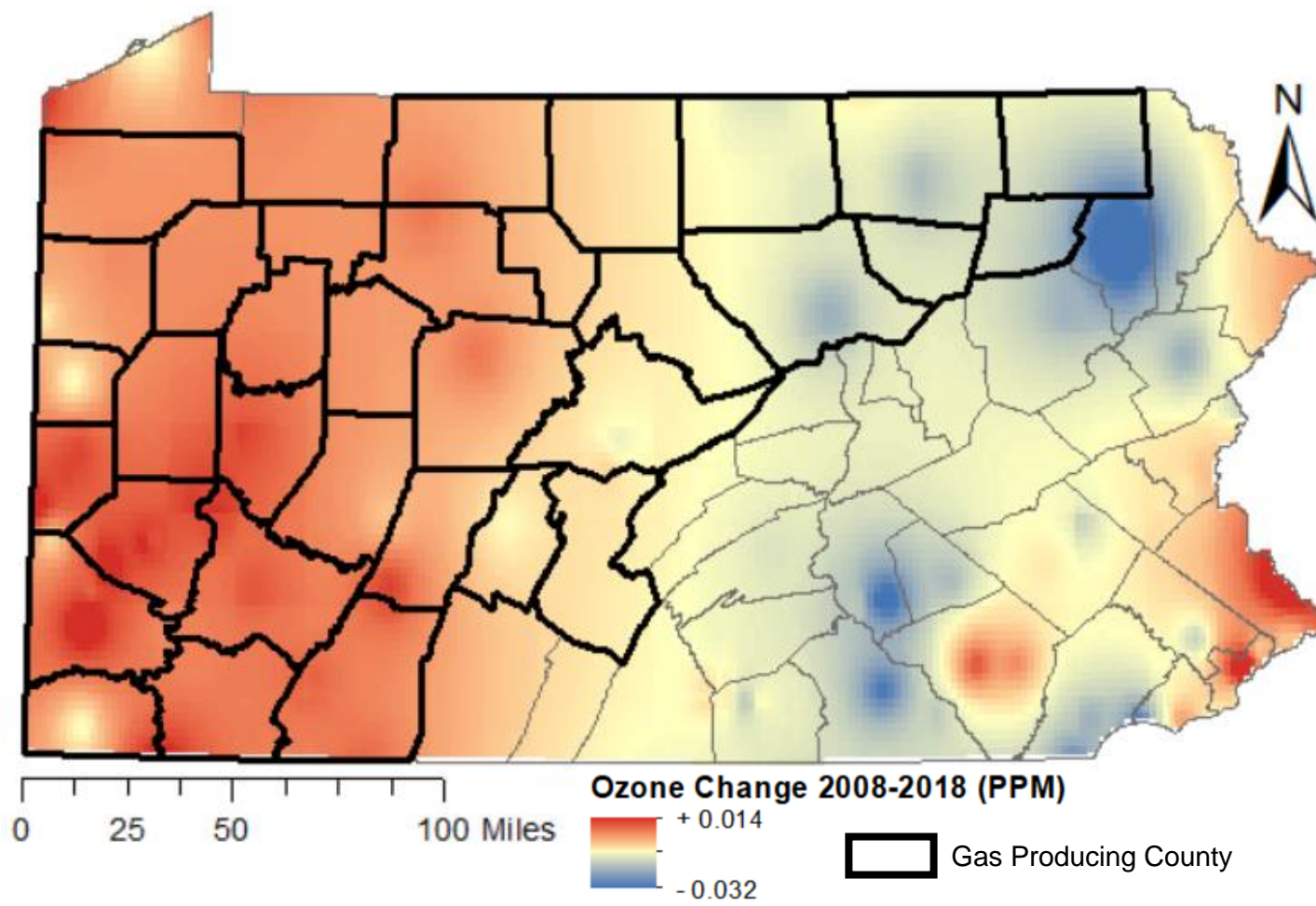
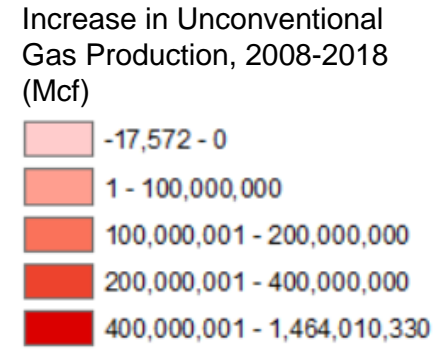
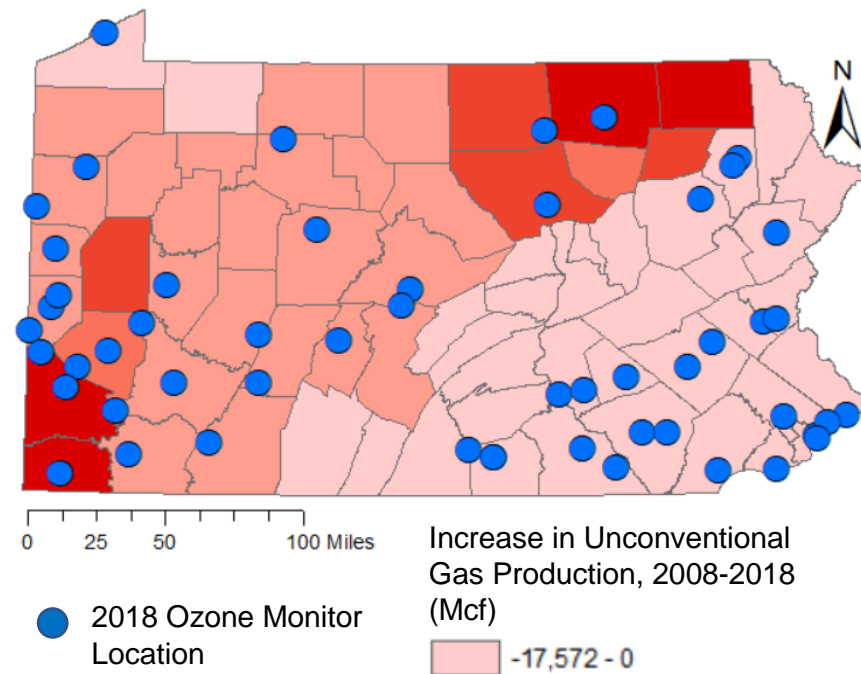


Methodology

Ozone emissions data in Pennsylvania and bordering states from EPA's air quality monitoring network was interpolated using Inverse Distance Weighting to estimate emissions across the state for 2008 and 2018. The raster calculator was used estimate increases and reductions in ozone emissions between the two years.

Zonal statistics was used to compare differences between natural gas producing and non-producing regions. The change in ozone emissions for each county was summed and these sums were averaged across counties with production and counties without production.

County Type	Average Change in Ozone Emissions, 2008-2018 (ppm)
Gas Production	0.75088
No Gas Production	-0.30468



Results and Conclusion

The map at left shows that counties with natural gas production generally saw an increase in ozone emissions while emissions in counties without production remained constant or decreased. In many areas, these increases came despite large decreases in electric sector NOx emissions, as shown in the two maps above. Ozone emissions are also concentrated around urban areas, reflecting the influence of transportation sector emissions. The table above confirms the visualization: average cumulative ozone emissions in counties with production increased by 0.75 ppm while emissions in counties without production decreased by 0.30 ppm. These data suggest that local emissions from natural gas production are offsetting broader state-wide reductions and that producing counties are not realizing the full air quality benefits brought by the gas they produce.

Additional research is needed to confirm these findings. Emissions from a wide range of sources can contribute to ozone formation and may be influencing the results. Studies that control for these emissions would allow for a clearer picture of gas production's contribution to ozone pollution. Regardless of the cause, gas producing regions are experiencing higher emissions. Expanding the monitor network, which has not changed substantially despite the increase in gas production, would improve understanding of production-related emissions and better inform and protect the people living in areas with natural gas production.

Data Sources

U.S. EPA (2008 and 2018), U.S. EIA (2008 and 2018), Pennsylvania Department of Environmental Protection (2008 and 2018), and Pennsylvania State University

Projection

All projections are polyconic