Chapter 7: Ambient Air Quality

Particulate Matter

The Acid Rain Program (ARP), NO_x Budget Trading Program (NBP), and the Clean Air Interstate Rule (CAIR) were designed to reduce sulfur dioxide (SO_2) and nitrogen oxides (NO_x) emissions from power plants. These pollutants contribute to the formation of ground level ozone (smog) and particulate matter (soot), which cause a range of serious health effects. The dramatic emission reductions achieved under these programs have improved air quality and delivered significant human health and ecological benefits across the United States.

To evaluate the impact of emission reductions on air quality, scientists and policymakers use data collected from long-term national air quality monitoring networks. These networks provide information on a variety of indicators useful for tracking and understanding trends in regional air quality over time and in different areas.

Analysis and Background Information

Particulate matter—also known as particle pollution or PM—is a complex mixture of extremely small particles and liquid droplets. Particle pollution is made up of a number of components, including acid-forming nitrate and sulfate compounds, organic chemicals, metals, and soil or dust particles. Fine particles ($PM_{2.5}$) can be directly emitted or can form when gases emitted from power plants, industrial sources, automobiles, and other sources react in the air.

Particle pollution—especially fine particles—contains microscopic solids or liquid droplets so small that they can get deep into the lungs and cause serious health problems. Numerous scientific studies have linked particle pollution exposure to a variety of problems, including: increased respiratory symptoms, such as irritation of the airways, coughing, or difficulty breathing; decreased lung function; aggravated asthma; development of chronic bronchitis; irregular heartbeat; nonfatal heart attacks; and premature death in people with heart or lung disease.

Particulate Matter Standards

The CAA requires EPA to set NAAQS for particle pollution. The first PM standard for fine particles was set by EPA in 1997 at 65 micrograms per cubic meter ($\mu g/m^3$) measured as the three year average of the 98th percentile for 24-hour exposure, and at 15 $\mu g/m^3$ for annual exposure measured as the three-year annual mean. EPA revised the air quality standards for particle pollution in 2006, tightening the 24-hour fine particle standard to 35 $\mu g/m^3$ and retaining the annual fine particle standard at 15 $\mu g/m^3$. In December 2012, EPA strengthened the annual fine particle standard to 12 $\mu g/m^3$. CAIR was promulgated to help downwind states in the eastern U.S. achieve the 1997 annual average $PM_{2.5}$ NAAQS, and, therefore, analyses in this report focus on that standard.

Key Points

PM Seasonal Trends

- Average $PM_{2.5}$ concentration data were assessed from 431 urban AQS areas located in the CAIR NO_x and SO_2 annual program region. Trend lines in $PM_{2.5}$ concentrations show decreasing trends in both the warm months (April to September) and cool months (October to March) unadjusted for the influence of weather.
- The annual average $PM_{2.5}$ concentration has decreased by about 40 percent in the warm season and about 34 percent in the cool season between 2001 and 2013.

Changes in $PM_{2.5}$ Nonattainment

- Thirty-six of the 39 designated nonattainment areas for the 1997 annual average $PM_{2.5}$ standard are in the East and are home to about 75 million people.[8, 9] The nonattainment areas were set in January 2005 using 2001 to 2003 data.
- Based on data gathered from 2011 to 2013, 32 of these original eastern areas show concentrations below the level of the 1997 $PM_{2.5}$ standard (15.0 µg/m^3), indicating improvements in $PM_{2.5}$ air quality. Four areas have incomplete data.
- Given that the majority of power sector annual NO_x and SO_2 emission reductions occurring after 2003 are attributable to the ARP, NBP, and CAIR, it is reasonable to conclude that these emission reduction programs have been a significant contributor to these improvements in $PM_{2.5}$ air quality.

More Information

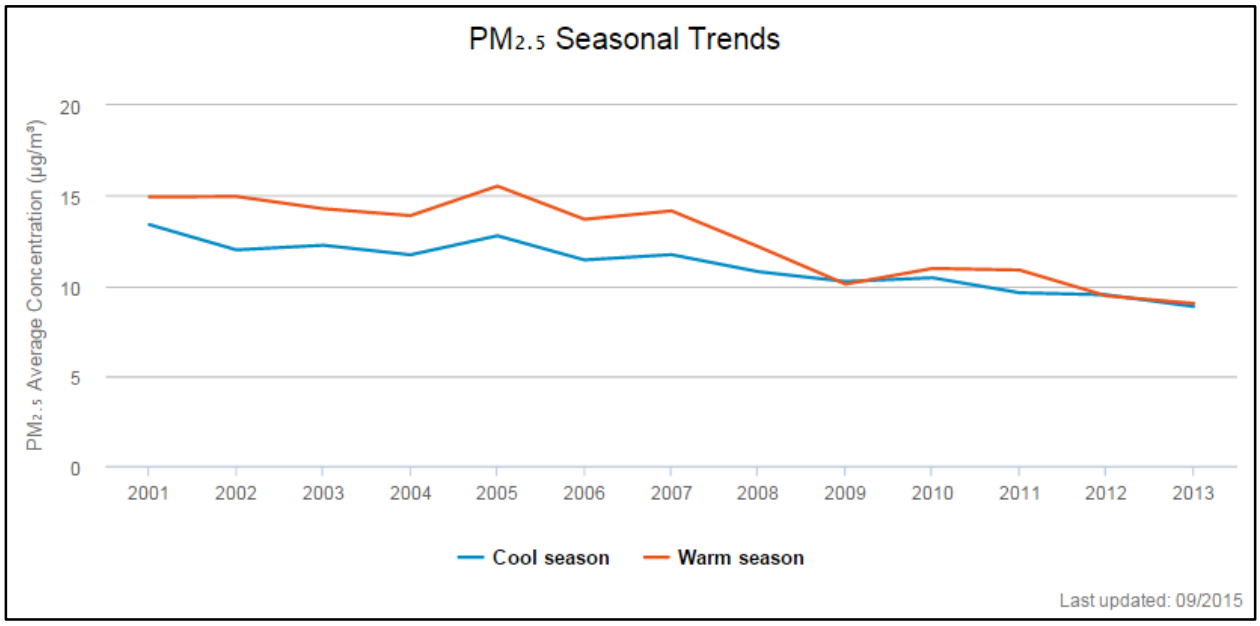
EPA's Power Plant Emission Trends page
http://www.epa.gov/airmarkets/progress/datatrends/index.html
Learn more about nitrogen oxides (NO_x) http://www.epa.gov/airquality/nitrogenoxides/
Learn more about Particulate Matter (PM) http://www.epa.gov/pm/
Learn more about National Ambient Air Quality Standards http://www3.epa.gov/ttn/naaqs/criteria.html
Learn more about EPA's Clean Air Market Programs http://www.epa.gov/airmarkets/programs

References

8. 40 CFR Part 81. Designation of Areas for Air Quality Planning Purposes.
9. U.S. Census. 2010.

Figures

Subtopic: Particulate Matter



Notes:

- For a $PM_{2.5}$ monitoring site to be included in the trends analysis, it had to meet all of the following criteria: 1) each site-year quarterly mean concentration value had to encompass at least 11 or more samples, 2) all four quarterly mean values had to be valid for a given year (i.e., meet criterion #1), and 3) all 12 years of site-level seasonal means had to be valid for the given site (i.e., meet criteria #1 and #2).
- Annual "cool" season mean values for each site-year were computed as the average of the first and fourth quarterly mean values. Annual "warm" season mean values for each site-year were computed as the average of the second and third quarterly mean values. For a given year, all of the seasonal mean values for the monitoring sites located in the CAIR Region were then averaged together to obtain a single year (composite) seasonal mean value.

Figure 1. $PM_{2.5}$ Seasonal Trends

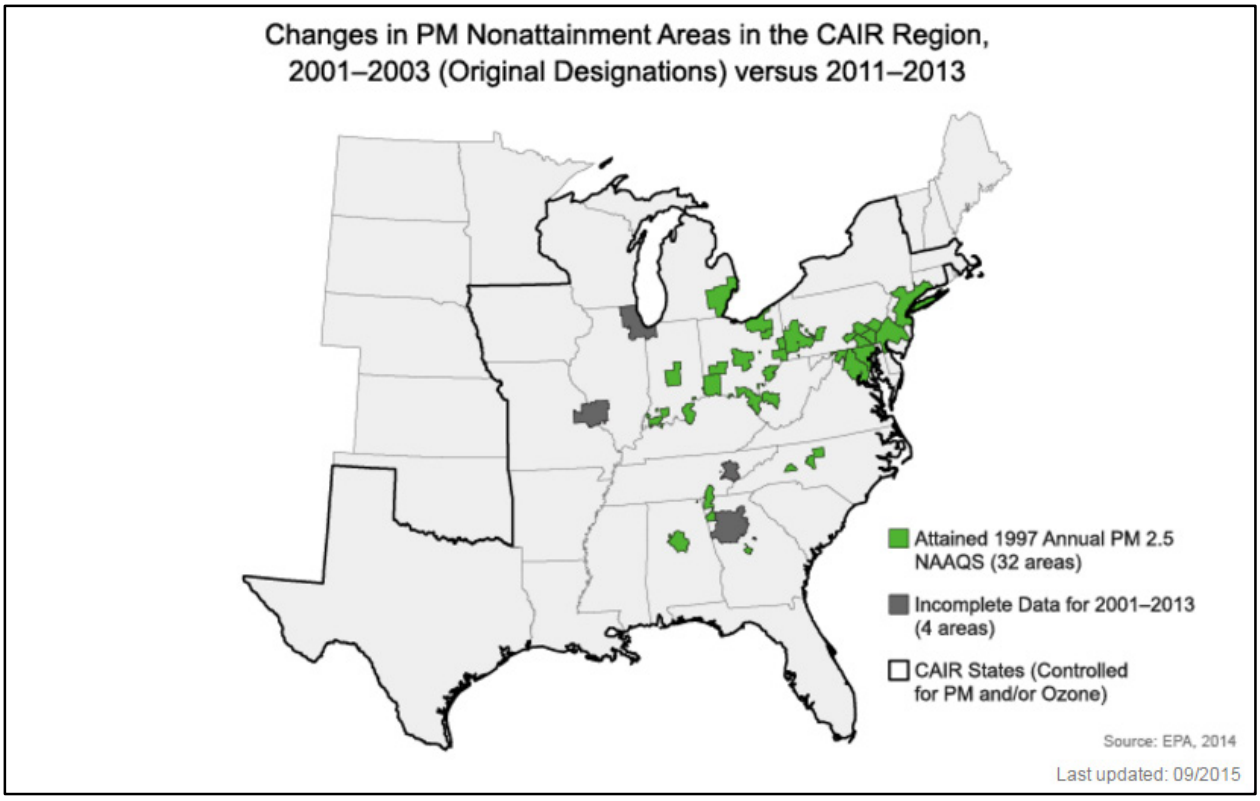


Figure 2. Changes in PM Nonattainment Areas in the CAIR Region, 2001–2003 (Original Designations) versus 2011–2013