

# Trends in Sulfur Pollutants, Nitrogen Pollutants, and Ozone throughout the U.S.

The Clean Air Status and Trends Network (CASTNET) was established to assess the effectiveness of SO<sub>2</sub> and NO<sub>x</sub> emission reductions produced by the Acid Rain Program (ARP) and more recent NO<sub>x</sub> emission control programs in the eastern United States. The U.S. Congress mandated that CASTNET provide consistent, long-term measurements for determining relationships between changes in emissions and any subsequent changes in air quality, atmospheric deposition, and ecological effects. EPA relies on CASTNET and other long-term national networks to generate the data needed to assess the effectiveness of mandated emission controls.

The ARP produced a decline in SO<sub>2</sub> emissions from 15.7 million tons in 1990 to 7.6 million tons in 2008 and a decline in NO<sub>x</sub> emissions from 6.7 to 3.0 million tons over the same 19 years. Furthermore, the NO<sub>x</sub> Budget Program (NBP) and its predecessor programs resulted in a decline in ozone (O<sub>3</sub>) season NO<sub>x</sub> emissions from NBP states in the eastern U.S. from 1.924 million tons in 1990 to 0.481 million tons in 2008.

CASTNET measurements of concentrations of SO<sub>2</sub>, particulate sulfate, HNO<sub>3</sub>, particulate nitrate and ammonium, and ozone, shown in the figures to the right, provide data to gauge the air quality benefits of the ARP and NBP promulgated emission reductions. CASTNET data collected at 34 eastern reference sites show the following declines in pollutant concentrations over the period 1990 through 2008 (i.e., 1990-92 versus 2006-08 mean levels):

- SO<sub>2</sub> – 48%
- Sulfate – 26%
- Total nitrate (HNO<sub>3</sub> + NO<sub>3</sub>) – 25%
- Ammonium – 26%
- Mean fourth highest daily max 8-hour average O<sub>3</sub> concentration of 69 ppb for 2008 (lowest in history of network).

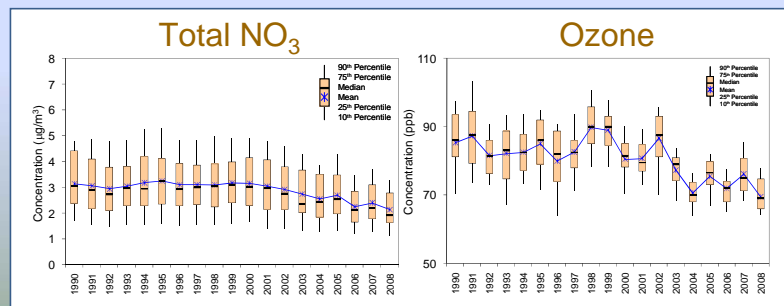
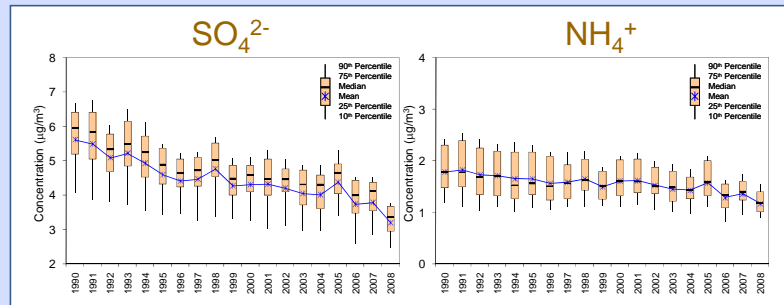
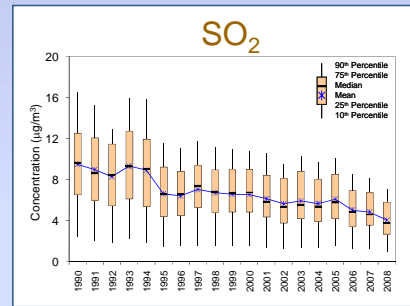
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Eastern Ref Sites

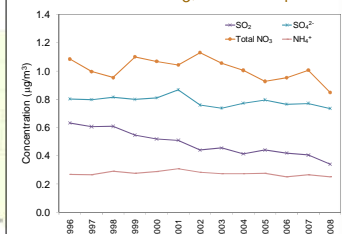


In addition to the time series for the eastern reference sites, concentrations over the period 1996–2008 were examined for the 17 CASTNET western reference sites.

The figure below shows time series of SO<sub>2</sub>, particulate SO<sub>4</sub><sup>2-</sup>, total nitrate, and particulate NH<sub>4</sub><sup>+</sup> measurements aggregated from the 17 sites. The figure shows a downward trend in annual mean SO<sub>2</sub> concentrations and no trend in the other three pollutants. Three-year mean SO<sub>2</sub> concentrations for 1990–1992 and 2006–2008 were 0.6 µg/m<sup>3</sup> and 0.4 µg/m<sup>3</sup>, respectively. This change constitutes a 37 percent reduction in 3-year mean SO<sub>2</sub> concentrations over the 13 years. The aggregated mean SO<sub>2</sub> concentrations from the western reference sites were more than 10 times lower than mean concentrations measured at the eastern reference sites.

Western Ref Sites

Time Series for SO<sub>2</sub>, SO<sub>4</sub><sup>2-</sup>, Total NO<sub>3</sub>, and NH<sub>4</sub><sup>+</sup>



Annual means of the fourth highest daily maximum 8-hour average ozone concentrations for the western reference sites are shown in the box plot below. No trend is evident over the 13-year period.

