# Long-term Monitoring and Accountability in Air Quality Planning

Kenneth L. Demerjian
Atmospheric Science Research Center
University at Albany - SUNY

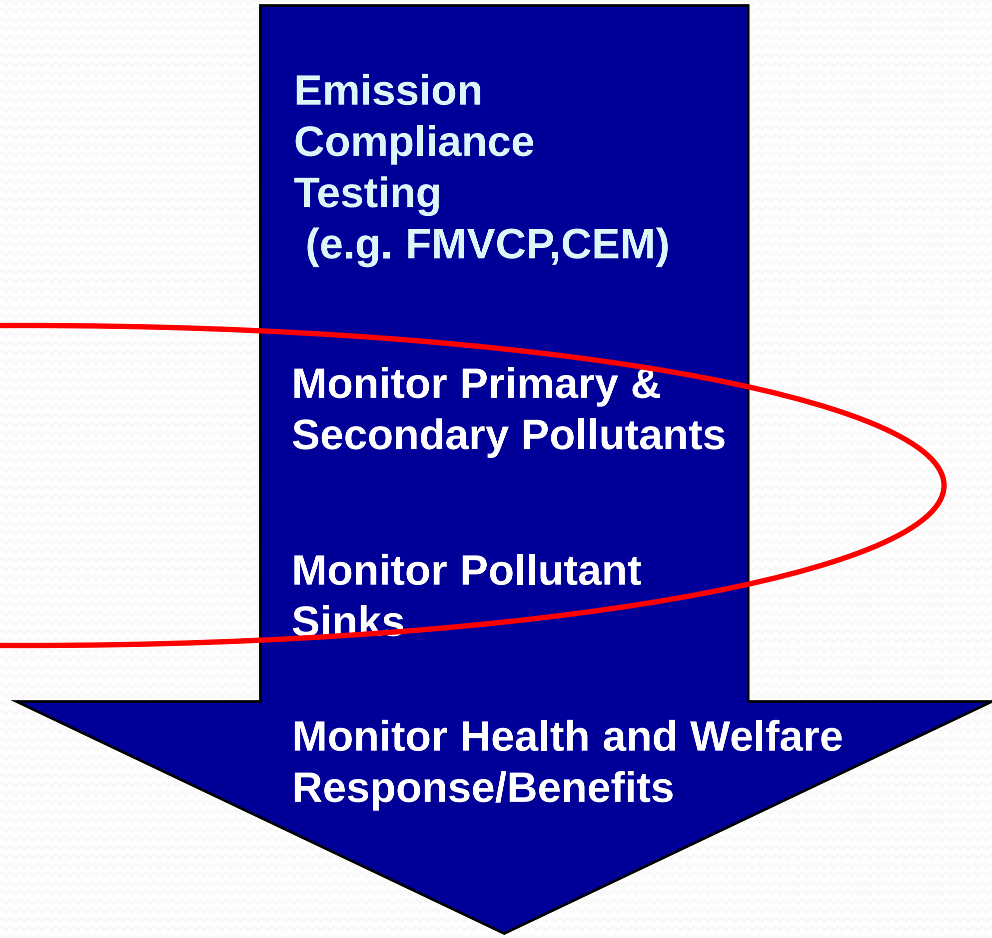
NYSERDA EMEP 2011 Meeting
November 15-16

# Accountability in Air Quality Management

- Accountability defines a formal process for determining whether or not a given air quality management action or combination of actions have achieved their intended objectives (i.e. improvements in air quality result in expected improvements in health and welfare outcomes).
- Accountability requires tracking the effectiveness of regulatory actions which in turn requires routine monitoring (over decades) within different regimes (e.g., urban and regional) to observe changes in chemical parameters that serve as effective markers of emission control and environmental protection.
- Long-term measurements improve our understanding of the process science so important to quantifying the transformation and fate of air pollutants.

# Accountability in the Management of Air Quality

- Principal steps in the process:
  - ***Verify that implemented emission controls are performing according to specifications***
  - ***Verify that environment resources (i.e., air, water, soil) are responding as expected to emission changes achieved***
  - ***Verify that the response of identified public health and environmental outcomes meet expectations given observed changes in environmental resource quality.***



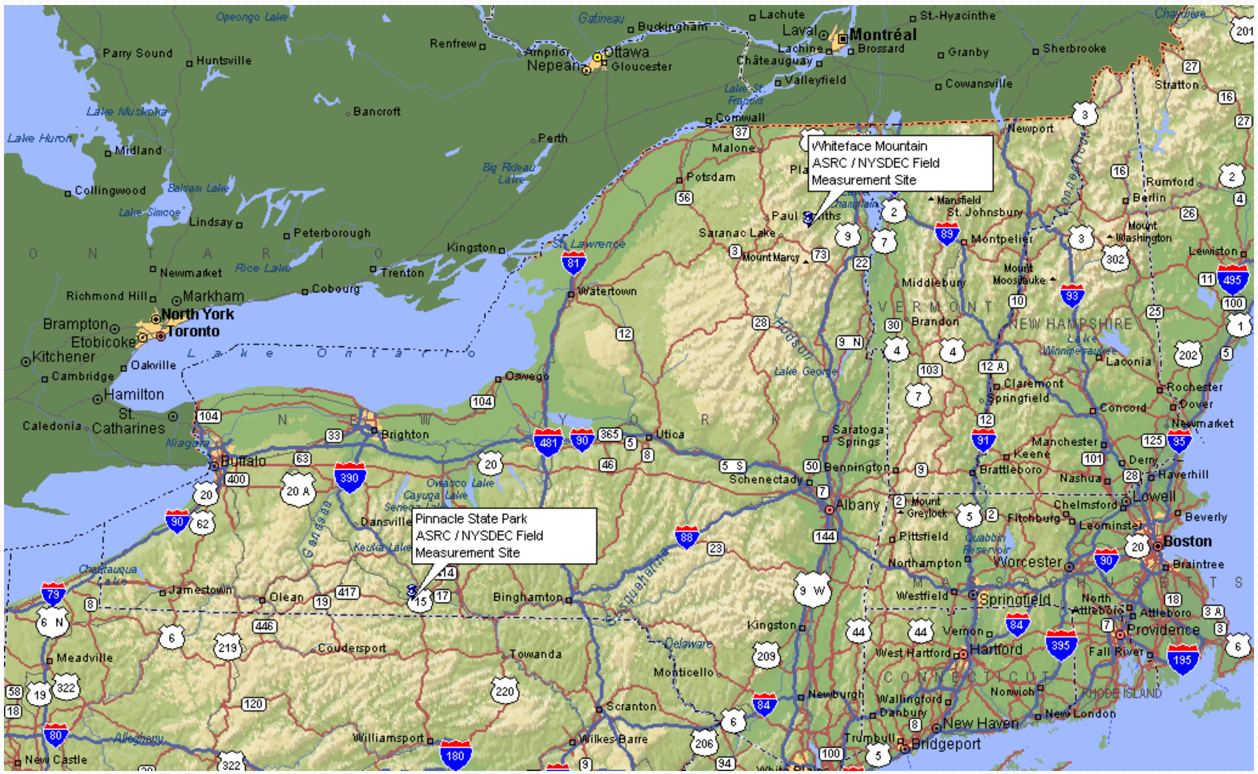
# Why is Accountability Important?

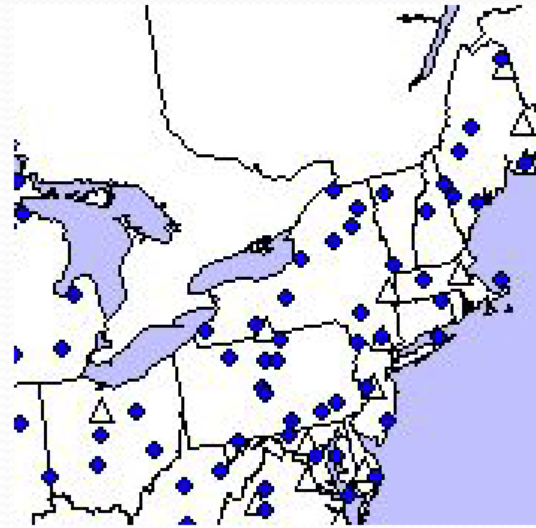
- To assure public trust and credibility, the science and policy communities must evaluate and verify the effectiveness of regulatory controls in terms of meeting established standards and achieving anticipated improvements in environmental health and welfare.
- Given the substantial costs to maintain the quality of our environment, it is reasonable to expect that analytical measures be in place to track progress and verify the success or failure of implemented environmental regulations.

# Accountability Based Trend Analyses

- Trends in $SO_2$ and NOx emissions and regional ambient concentrations and wet deposition
- Trends in CO and NOx transportation emissions and urban ambient concentrations
- Monitoring Changes in PM composition
- Trends in ozone production efficiencies

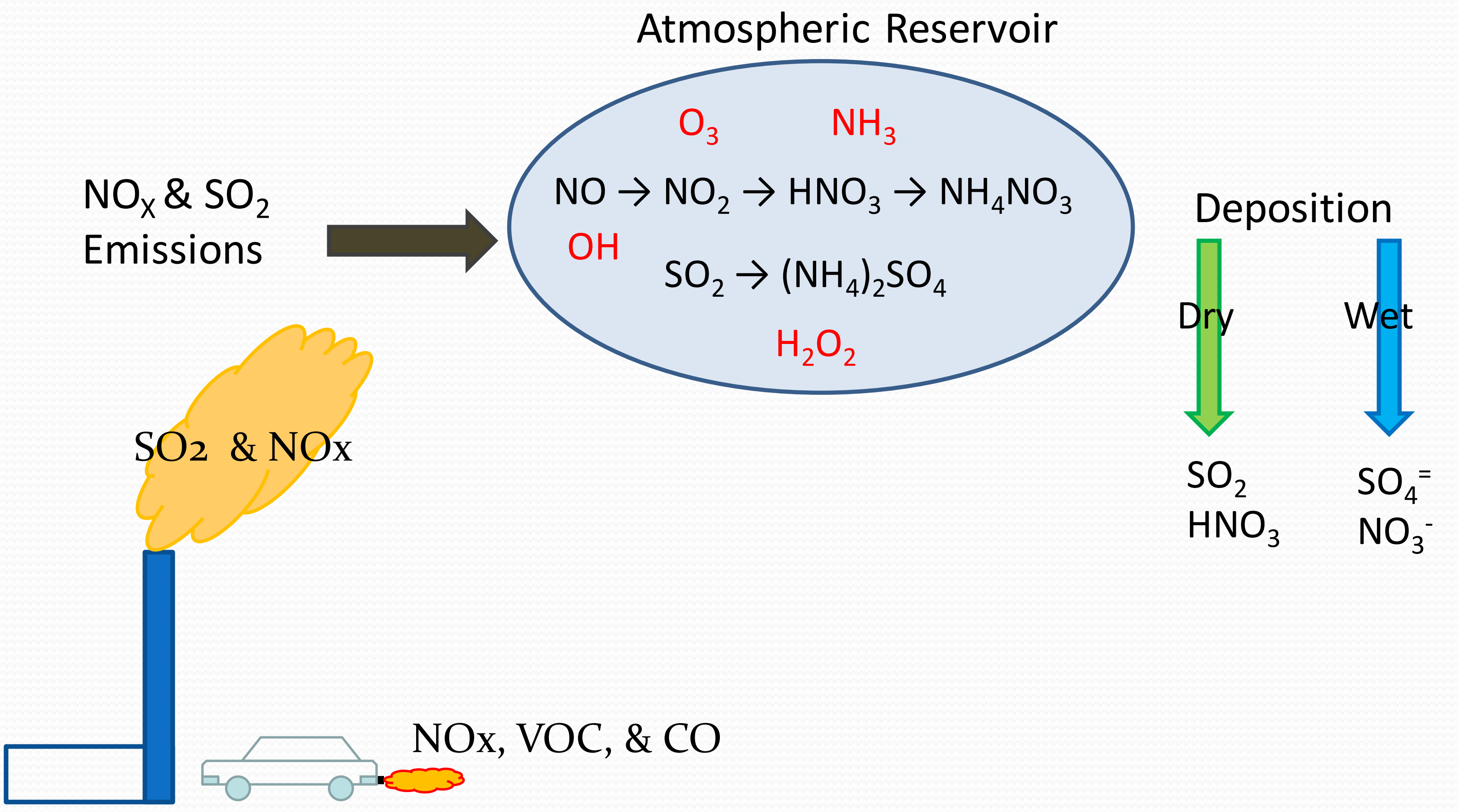
# Data Resources



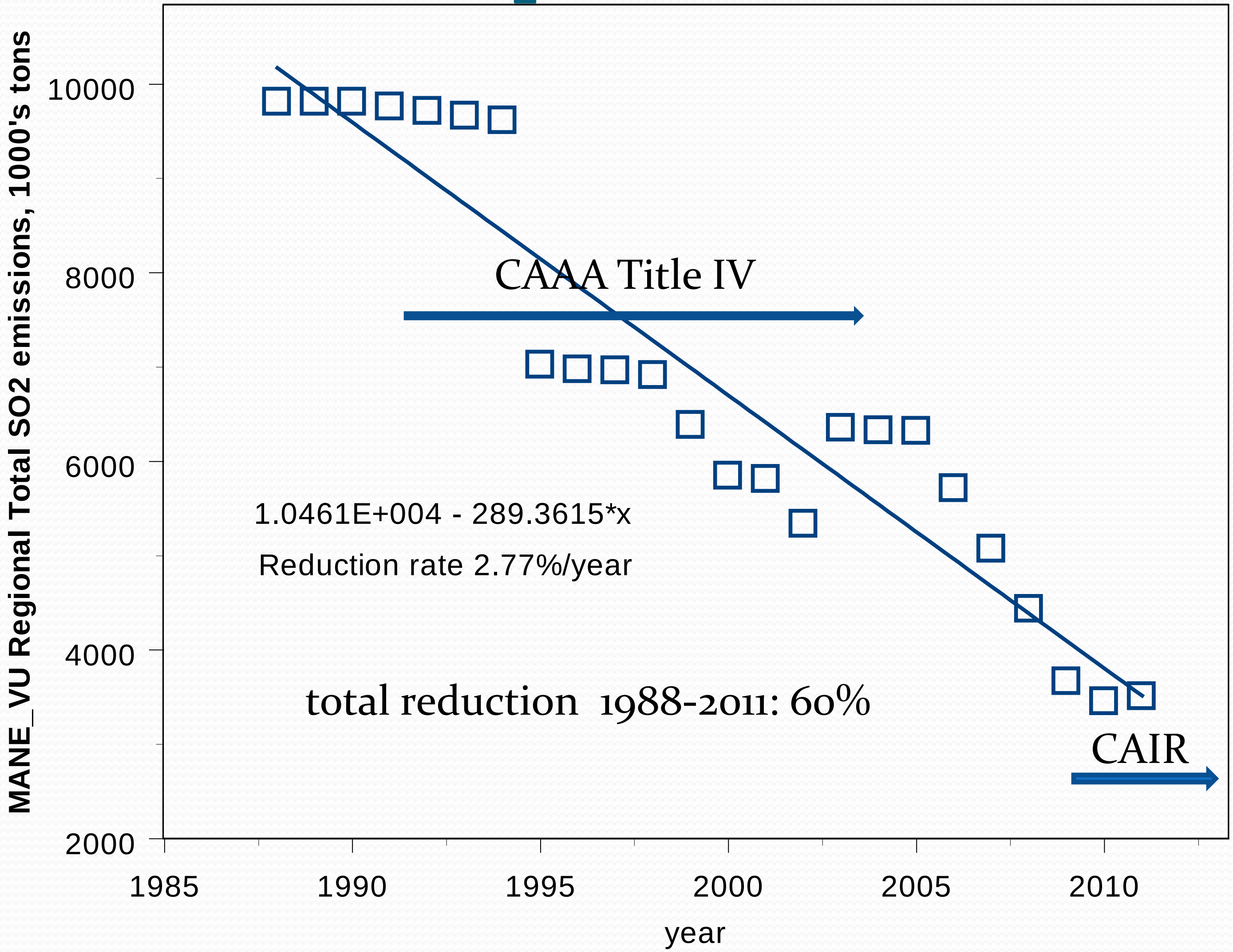



National Acid Deposition Program OH, PA, NY,VT

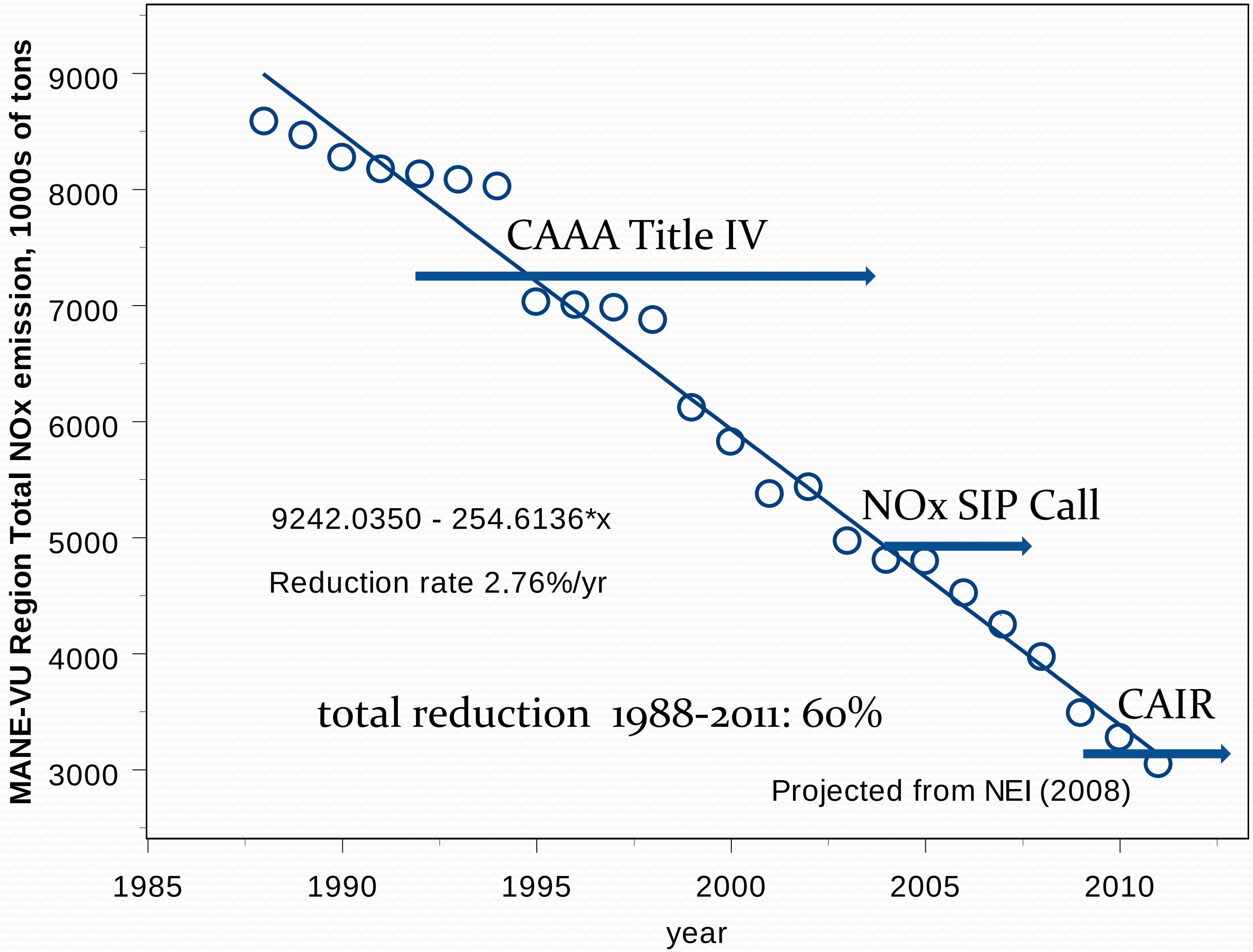
# The Fate of $SO_2$ and NOx emissions



# Are regulatory emission controls meeting expectations – $SO_2$



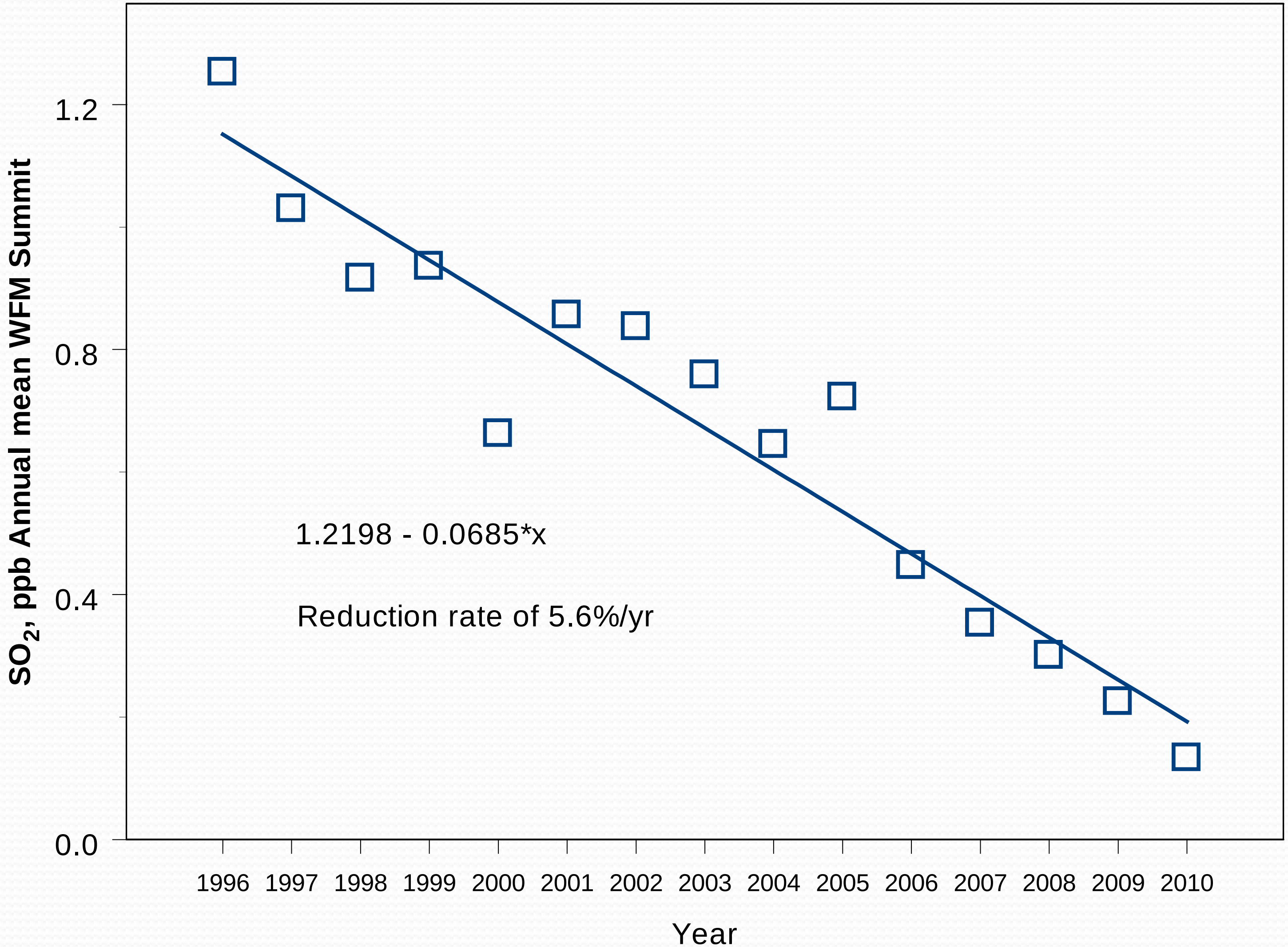
# Are regulatory emission controls meeting expectations - NOx



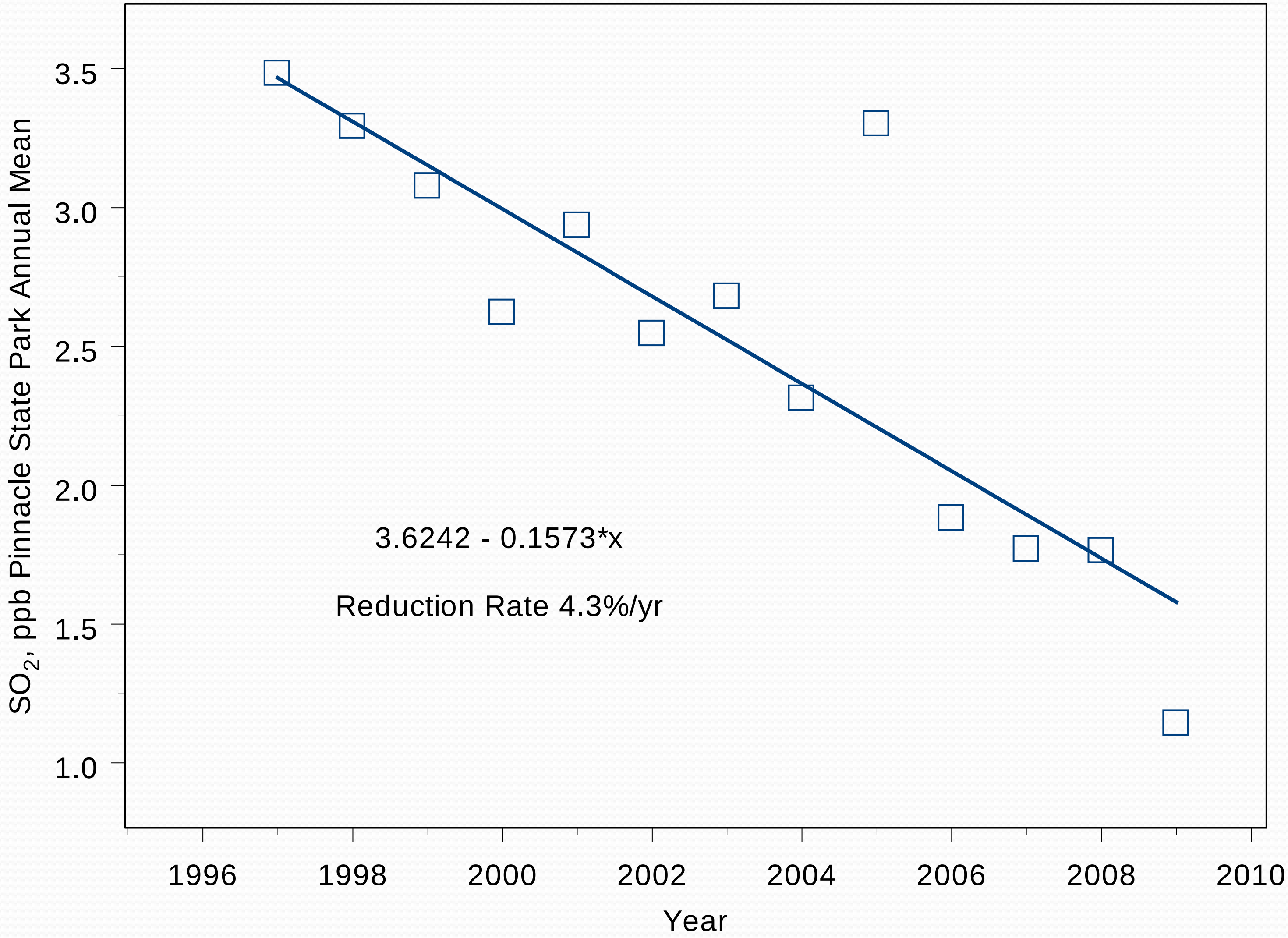
# Regulatory Emission Control Actions

| Regulatory Action | Anticipated Reduction, $SO_2$ | Anticipated Reduction, $NO_x$ |
|---|---|---|
| CAAA Title IV Phase 2 | (1990-2005) 5.5M t, ~ -35% | (1990-2005) 3M t, ~ -50% |
| NOx SIP Call | NA | (2003-2008) 0.5M t, ~ -10% |
| CAIR/CSAPR (projected) | (2010-2015) 7M t, ~ -73% (2003-2015) | (2009-2015) 2M t, ~ -61% (2003-2015) |
| Tier 2 Gas V, HD Diesel, NR HD Diesel | < 1% | 2007- 2030 6M t, ~ - 60% |

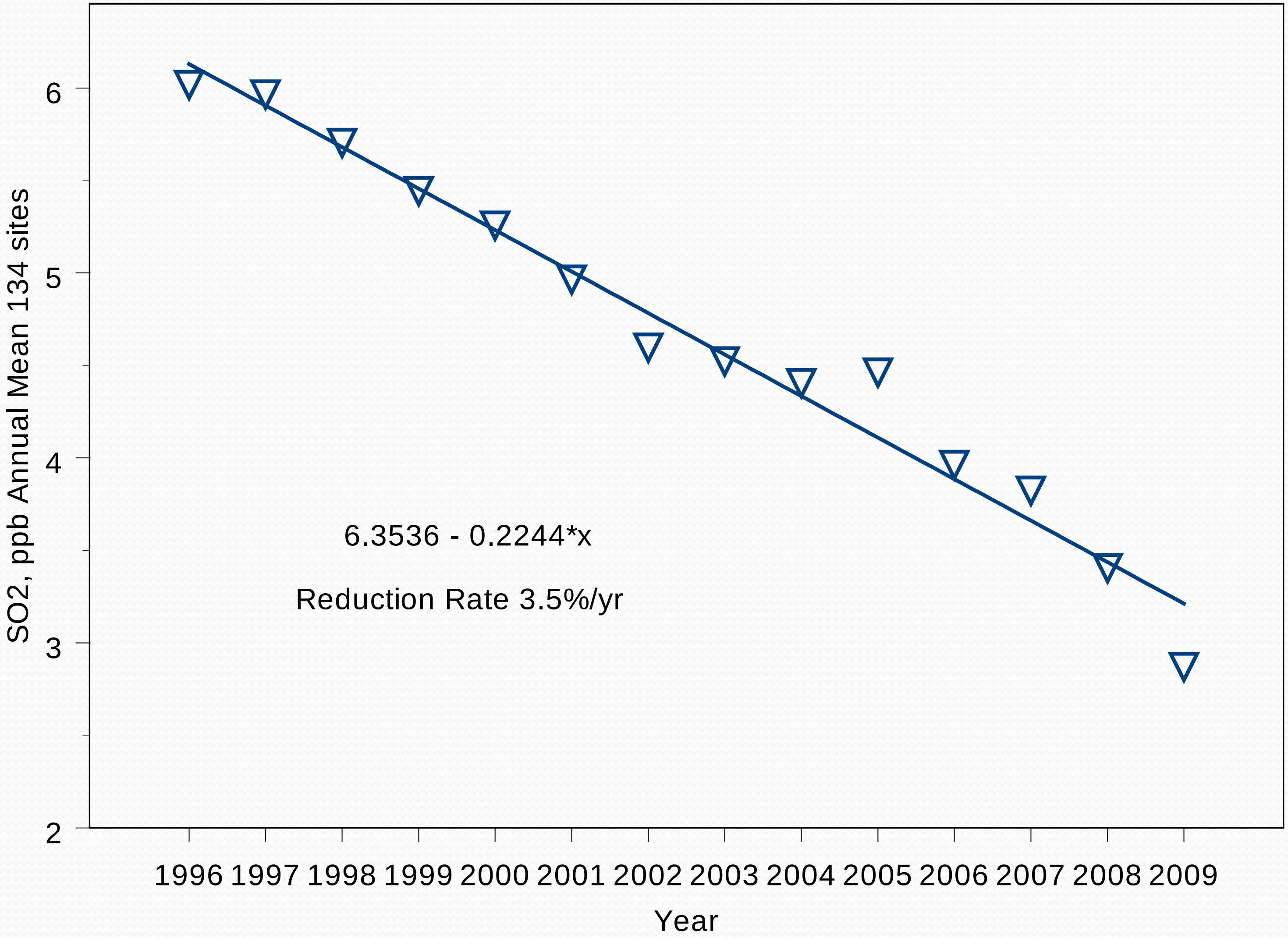
# Annual Mean $SO_2$ WFM 1996-2010



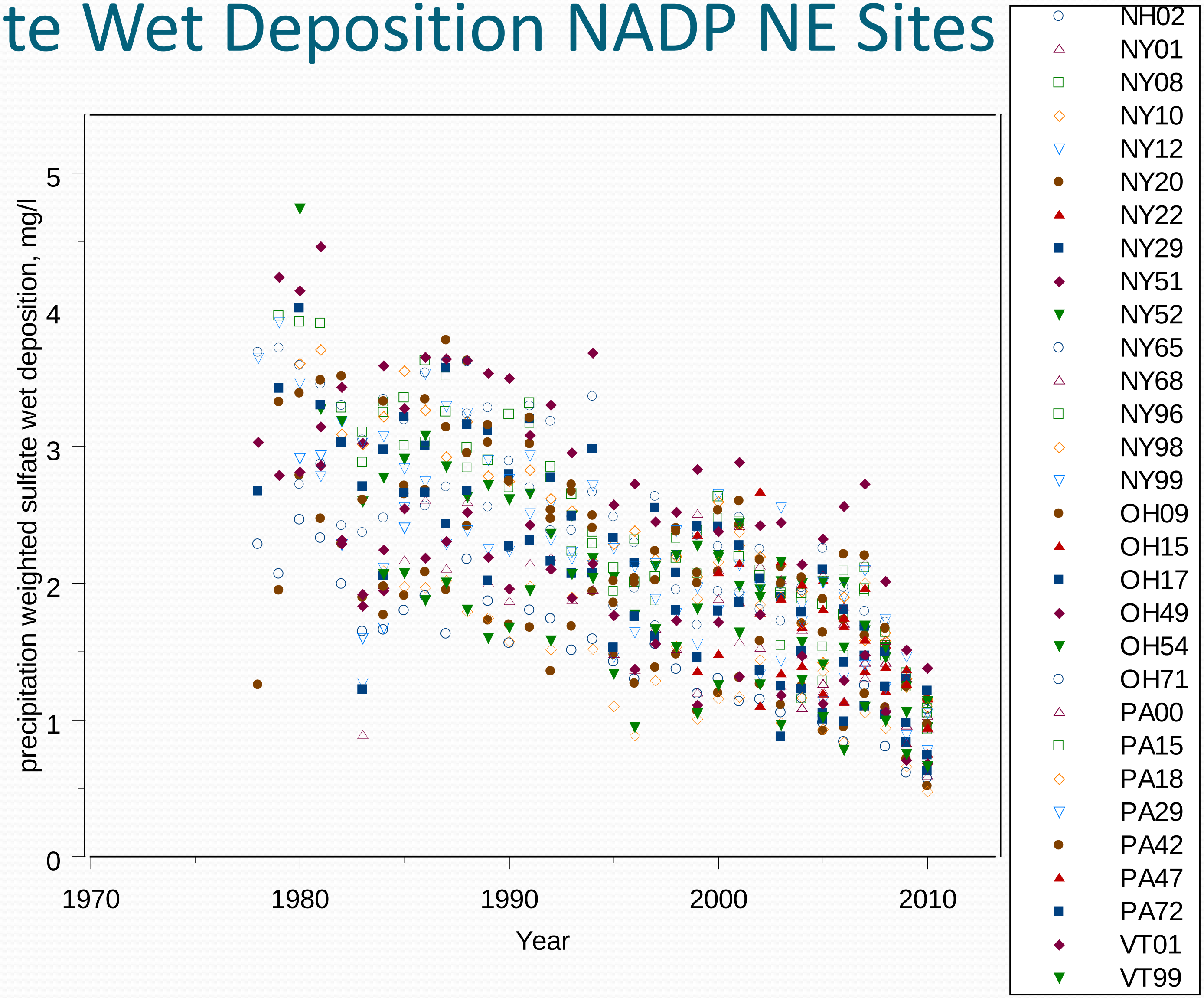
# Annual Mean $SO_2$ Pinnacle State Park 1996-2009



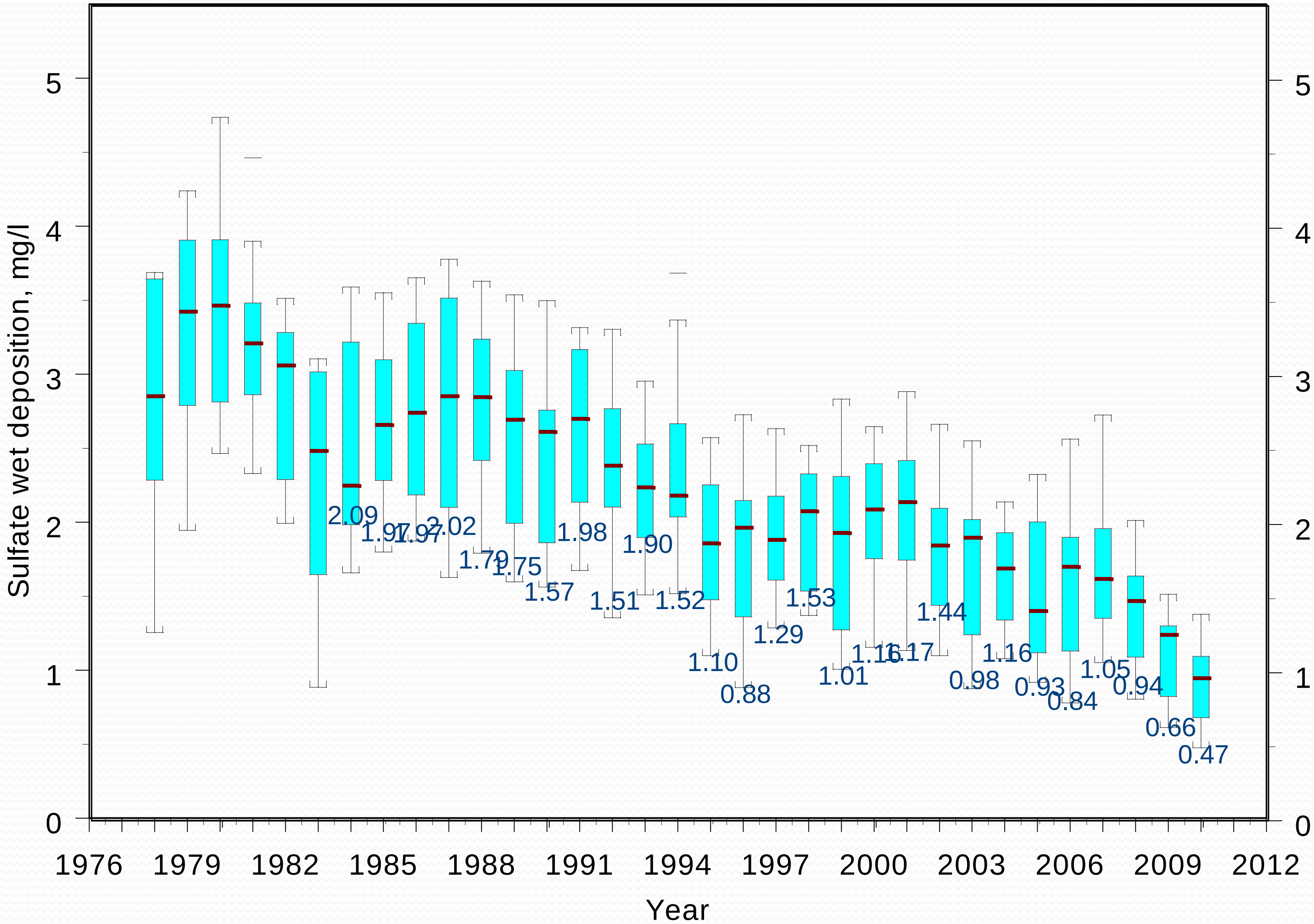
# Annual Mean $SO_2$ 134 sites EPA NTN 1996-2009



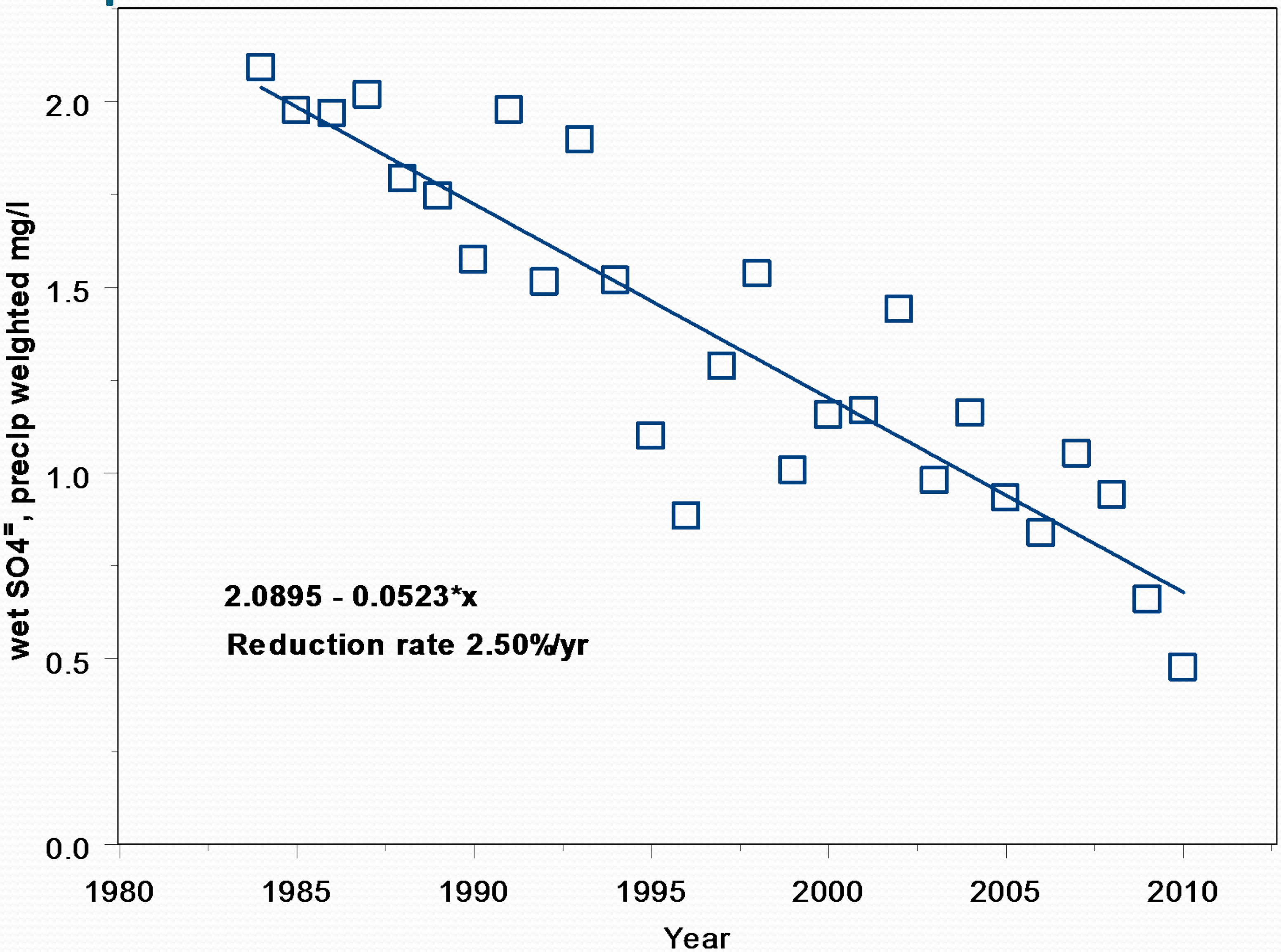
# Precipitation Weighted Annual Average Sulfate Wet Deposition NADP NE Sites



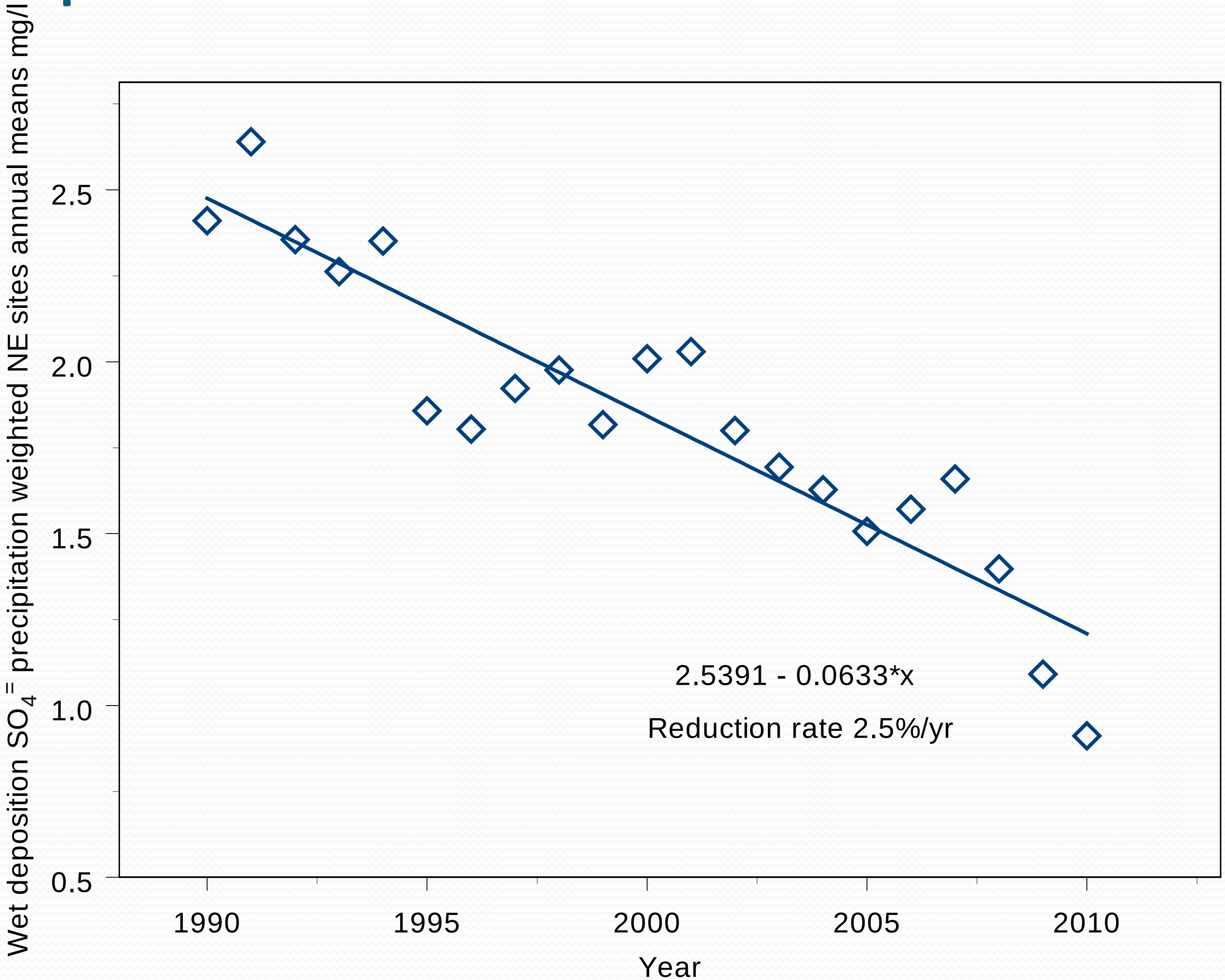
# Mean Precipitation weighted $SO_4^{=}$ Wet Deposition NADP NE Sites vs NY98 (WFM)



# Precipitation Weighted Wet Sulfate Deposition Whiteface Mountain



# Precipitation Weighted Wet Sulfate Deposition NADP NE Sites



# Summary of Sulfur Oxides Trend Analyses

| Metric | Observed Change |
|---|---|
| Annual Emissions $SO_2$ (OTAG Region 1988-2011) | - 2.8 %/yr |
| Annual Mean $SO_2$ WFM Summit (1996-2010) | - 5.6 %/yr |
| Annual Mean $SO_2$ PSP (1996-2009) | - 4.3 %/yr |
| Annual Mean $SO_2$ NTN 134 sites (1996-2009) | - 3.5 %/yr |
| Annual Mean Wet Sulfate Deposition WFM (1990-2009) | - 2.5 %/yr |
| Annual Mean Wet Sulfate Deposition NE sites (1990-2009) | - 2.5 %/yr |
| Cloud Water Sulfate WFM Summit (1994-2005) | - 3.6%/yr |

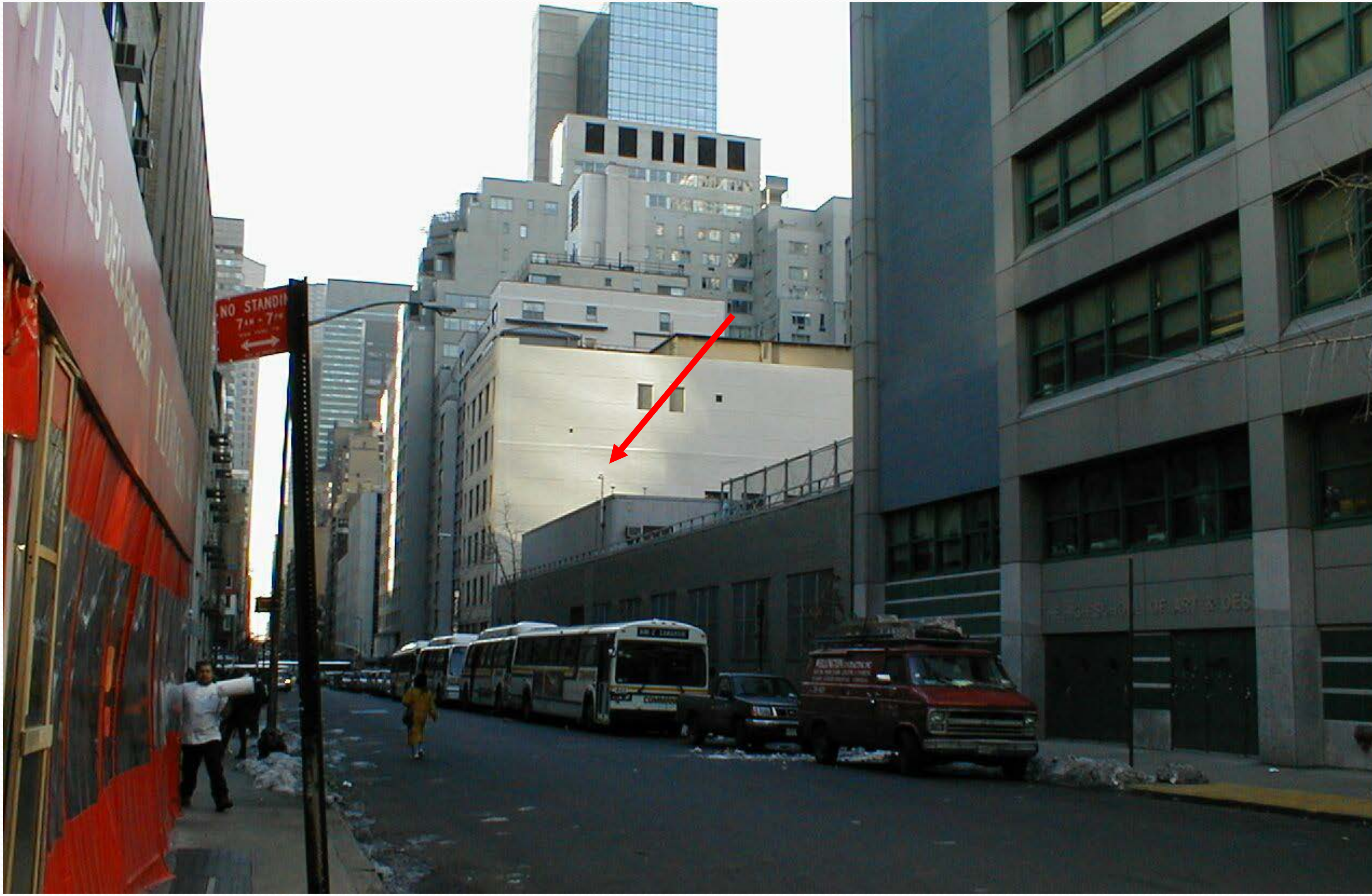
# Summary of Nitrogen Oxides Trend Analyses

| Metric | Observed Change |
|---|---|
| Annual Emissions NOx (OTAG Region 1988-2011) | - 2.8 %/yr |
| Annual Mean NOy WFM Summit (1996-2010) | ------- |
| Annual Mean NOy PSP (1997-2009) | - 2.6 %/yr |
| Annual Mean NOx PSP (1997-2009) | - 3.6 %/yr |
| Annual Mean NO2 NTN 134 sites (1996-2009) | - 2.0 %/yr |
| Annual Mean Wet Nitrate Deposition WFM (1990-2009) | - 1.9 %/yr |
| Annual Mean Wet Nitrate Deposition NE sites (1990-2009) | - 2.5 %/yr |
| Cloud Water Nitrate WFM Summit (1994-2005) | - 2.3 %/yr |

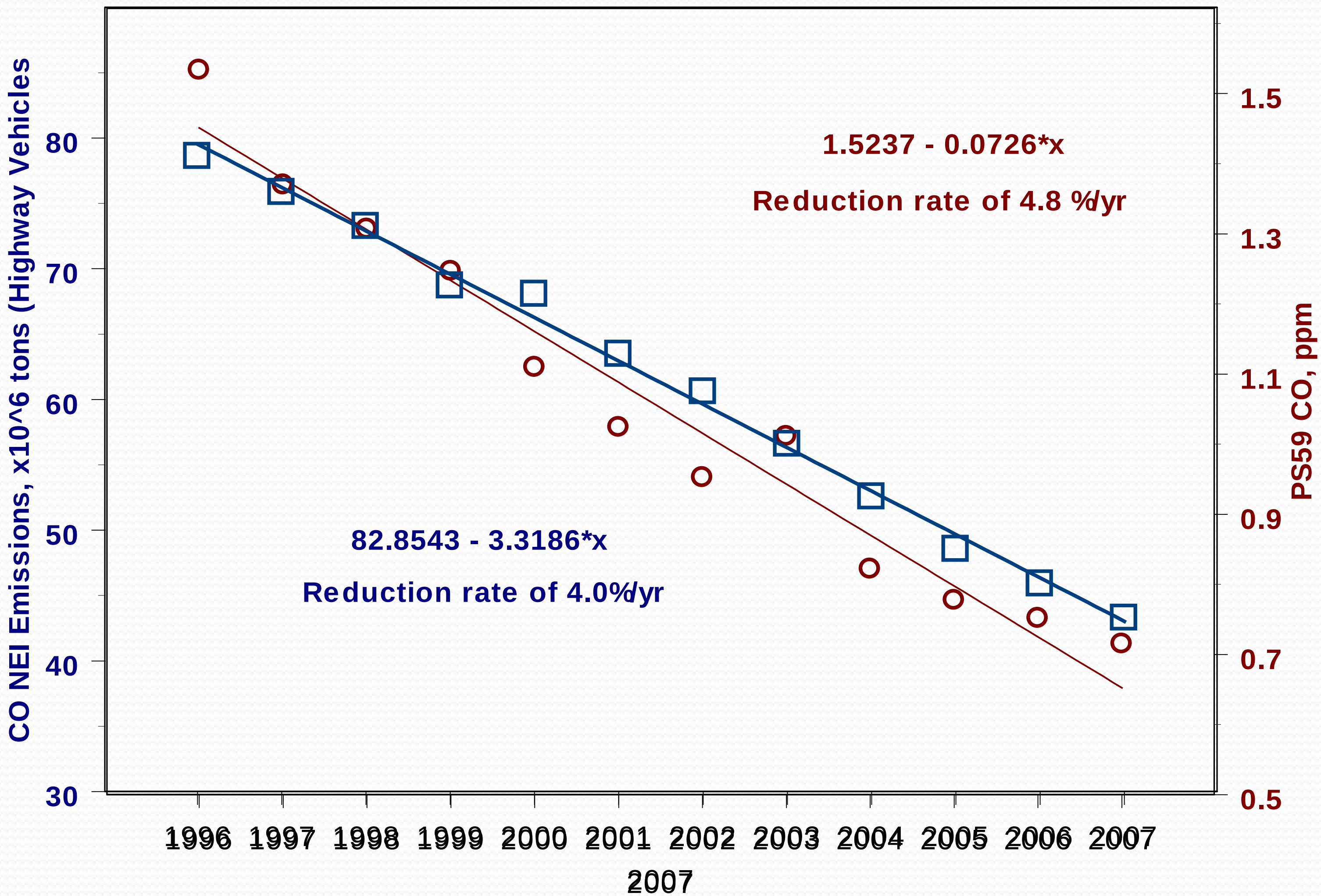
# Queens College and PS 59 NYC Site Locations

# PS 59 Roadside Monitoring Site

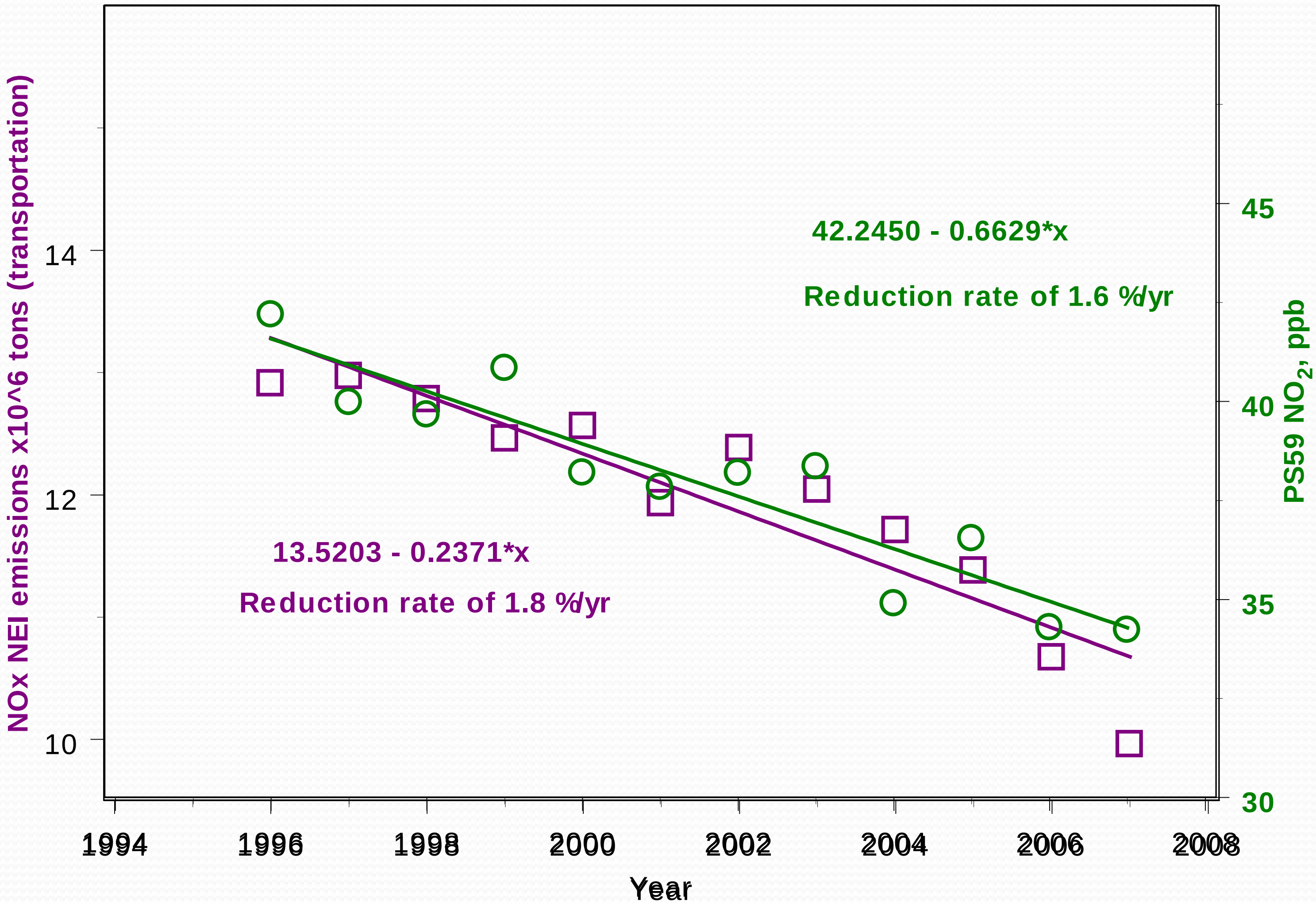
## 228 East 57$^{th}$ St., NYC



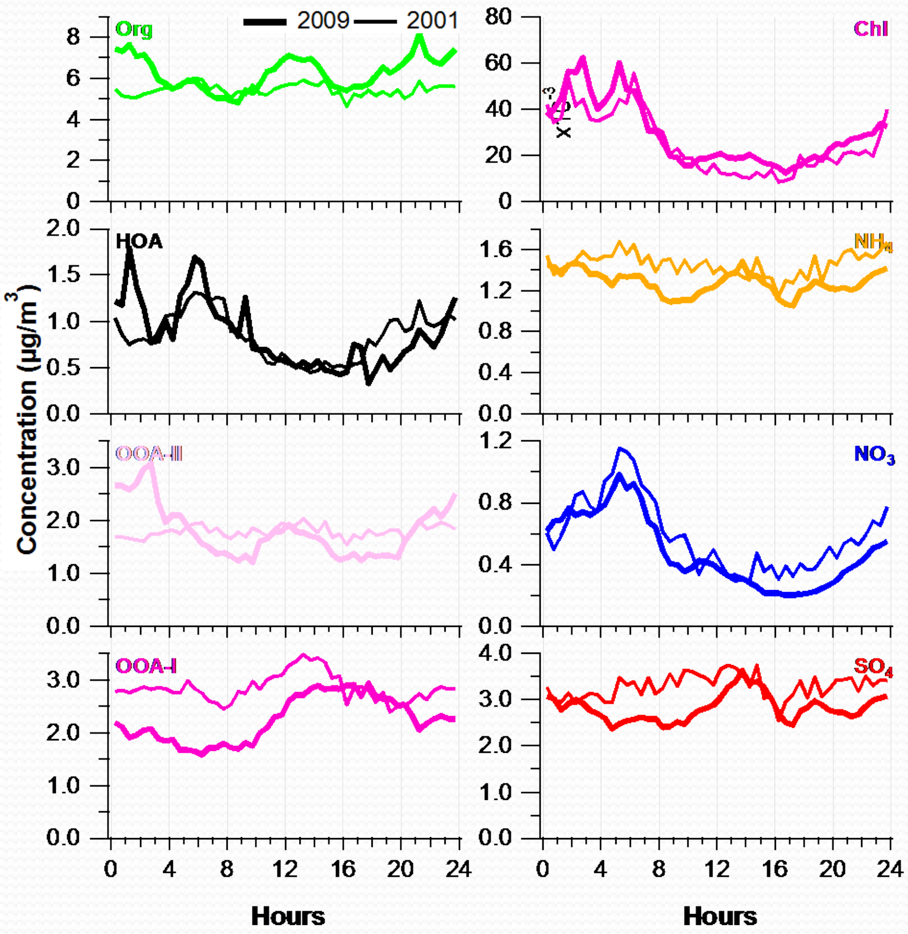
# NEI Annual CO Highway Emission vs. Concentration Trend (1996-2007)



# NEI Annual NOx Transportation Emission vs. $NO_2$ Trend PS59 (1996-2007)

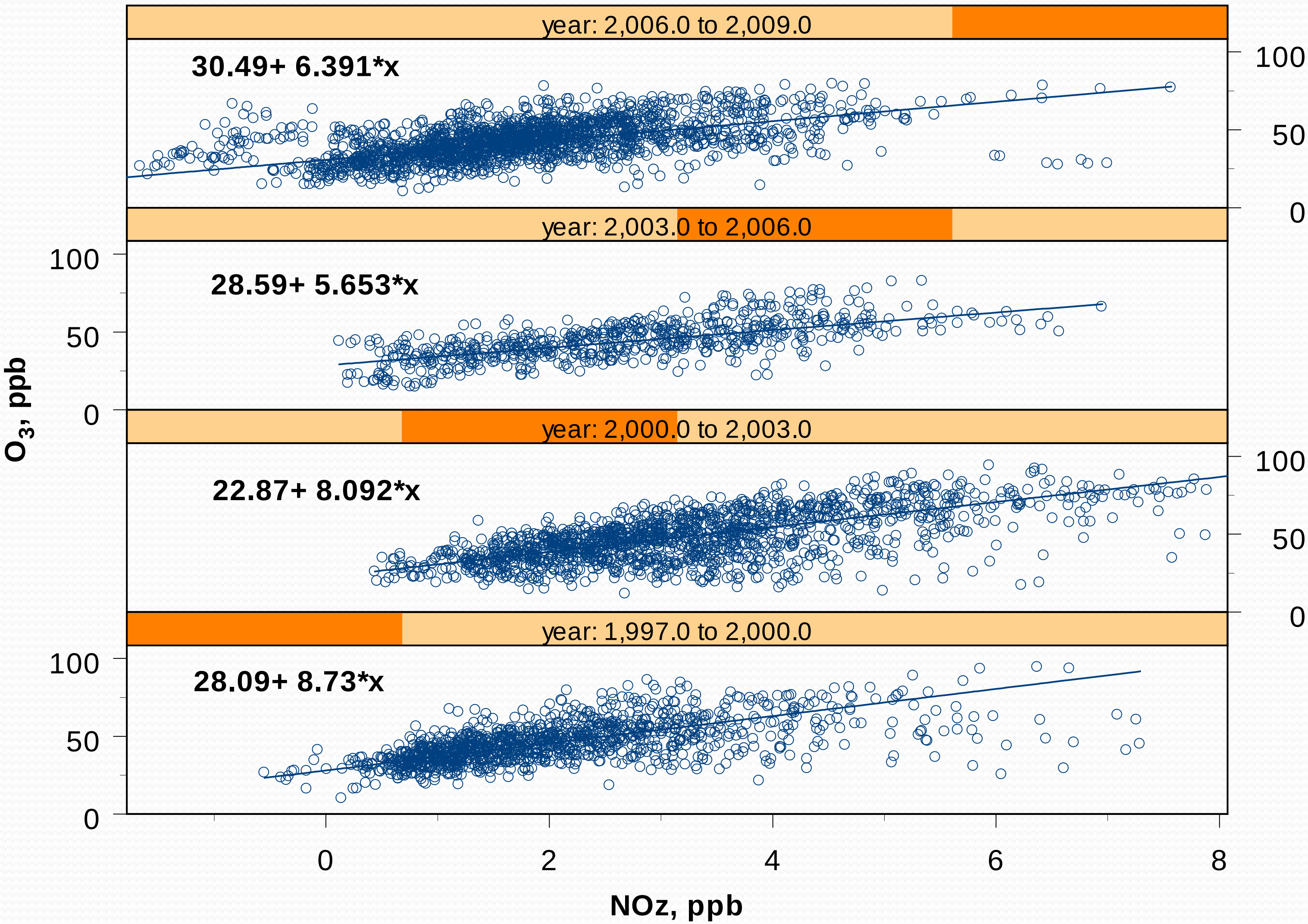


# Changes in Mean Diurnal PM1.0 Chemical Composition Queens College 2001 vs. 2009




- Based on AMS Measurements (July 14 – August 3) reporting similar mean mass concentrations (12 µg/m$^3$, 11µg/m$^3$, 2001 & 2009 respectively)
- Reduction in $SO_2$ and $NO_x$ emissions are reflected in reductions in PM sulfate and nitrate
- Reduction in PM sulfate and nitrate mass has been replaced by PM organic mass

# Ozone Production Efficiency 1997-2009 PSP
# June - August, hrs: 10am–4pm



# Outstanding challenges to accountable air quality management

- Sustained long term measurements of primary and secondary air pollutants and associated dry and wet deposition sinks.
- Development of long term data bases of health and ecological outcomes.
- Introduction of the measurement of select chemical parameters which provide critical insights to chemical transformation processes affecting secondary pollutant production.

# Acknowledgment

**J. Schwab and U. Roychowdhury, Atmospheric Sciences Research Center, University at Albany, SUNY**

**D. Felton and O. Rattigan, NYS Department of Environmental Conservation**

NYSERDA Contract #10602