North Carolina Approach to Weight of Evidence

March 28, 2007
Region 4 Modelers Workshop
Atlanta, GA

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North Carolina Division of Air Quality

Weight of Evidence

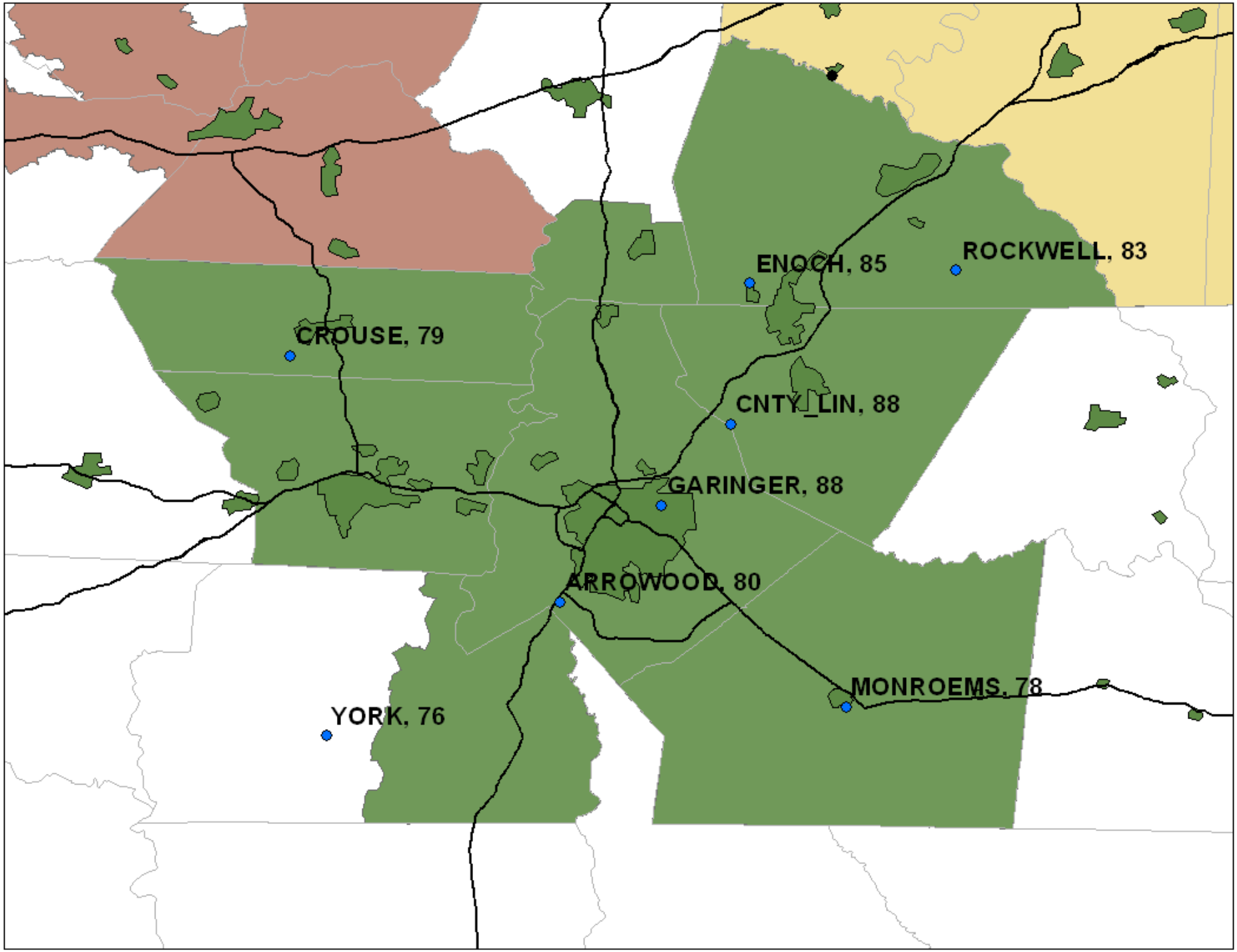
- Observational analyses
- Emissions analyses
- Variations of the modeling data

Observations

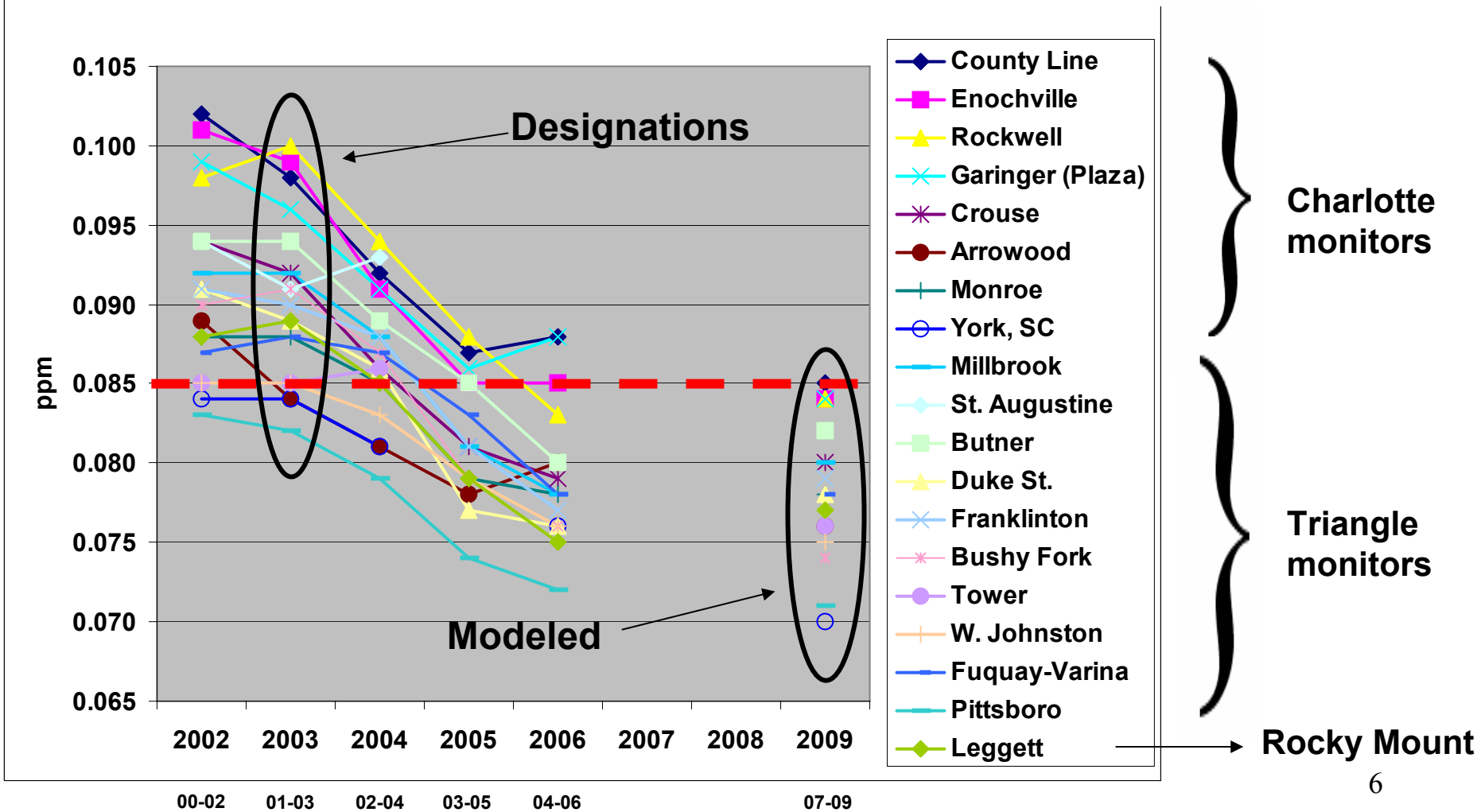
- Current 2004-2006 ozone design values are not much higher than the standard or the 2009 modeled design values in the Charlotte area.

Design Values in Charlotte

	2004-2006	2009 (modeled)
County Line	88 ppb	85 ppb
Garinger	88 ppb	84 ppb
Enochville	85 ppb	84 ppb
Rockwell	83 ppb	83 ppb
Arrowood	80 ppb	75 ppb
Crouse	79 ppb	78 ppb
Monroe	78 ppb	76 ppb
York	76 ppb	71 ppb

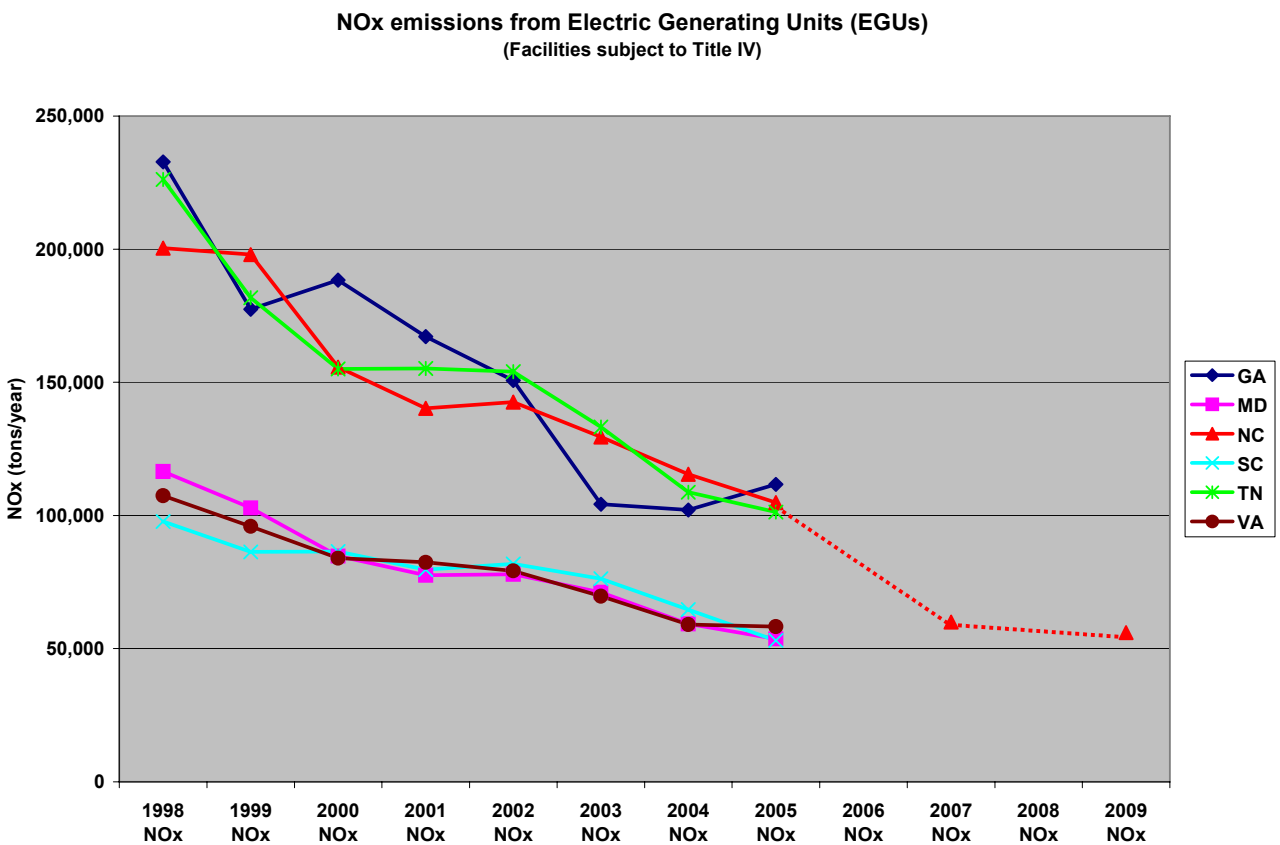

ENOCH, 85
ROCKWELL, 83
CROUSE, 79
CNTY_LIN, 88
GARINGER, 88
ARROWOOD, 80
MONROEMS, 78
YORK, 76

Past, Present and Future 8-hour Ozone Design Values



Observations

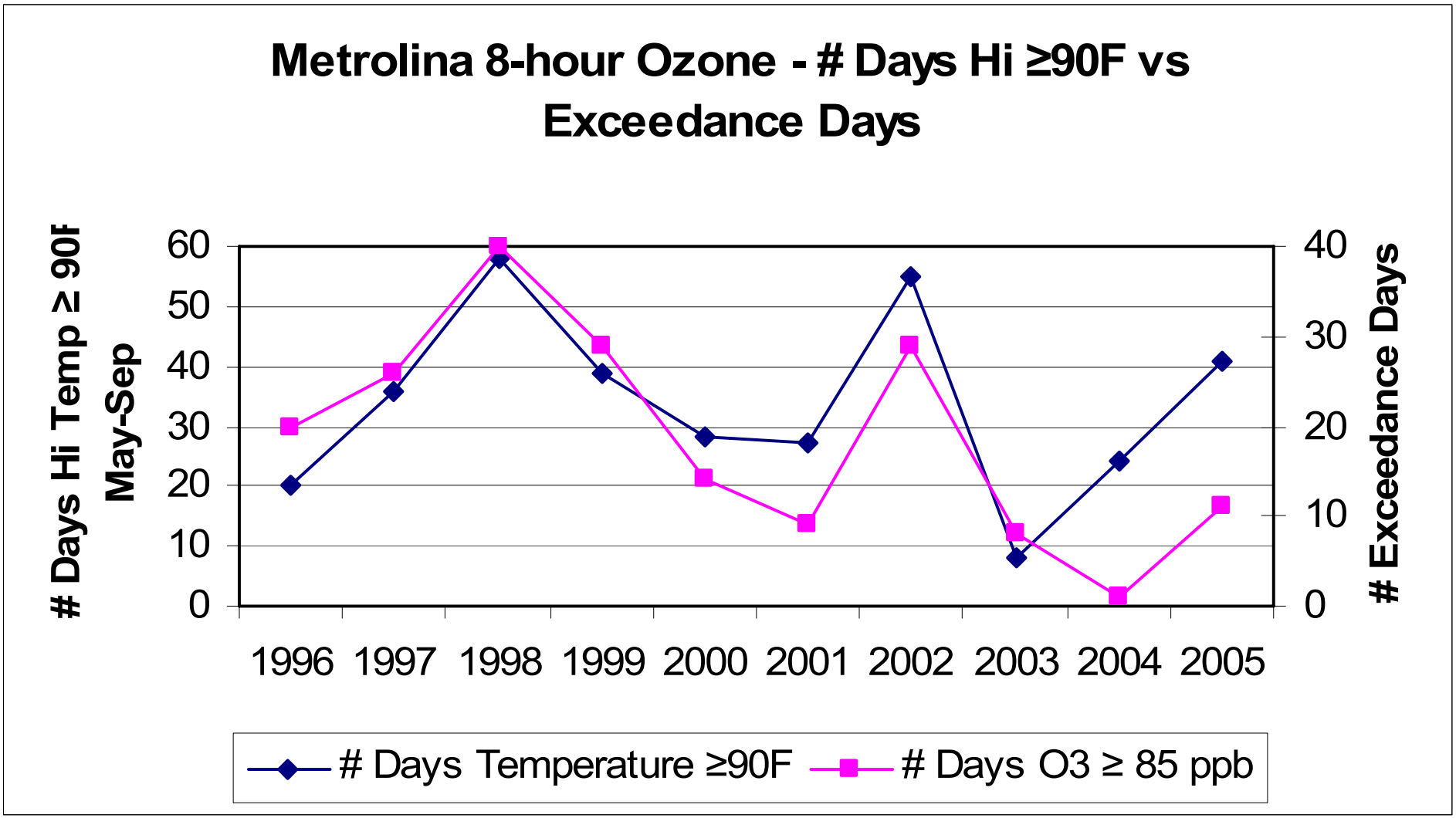
- **NOx reductions that have occurred since 2002 have resulted in real reductions in ozone**



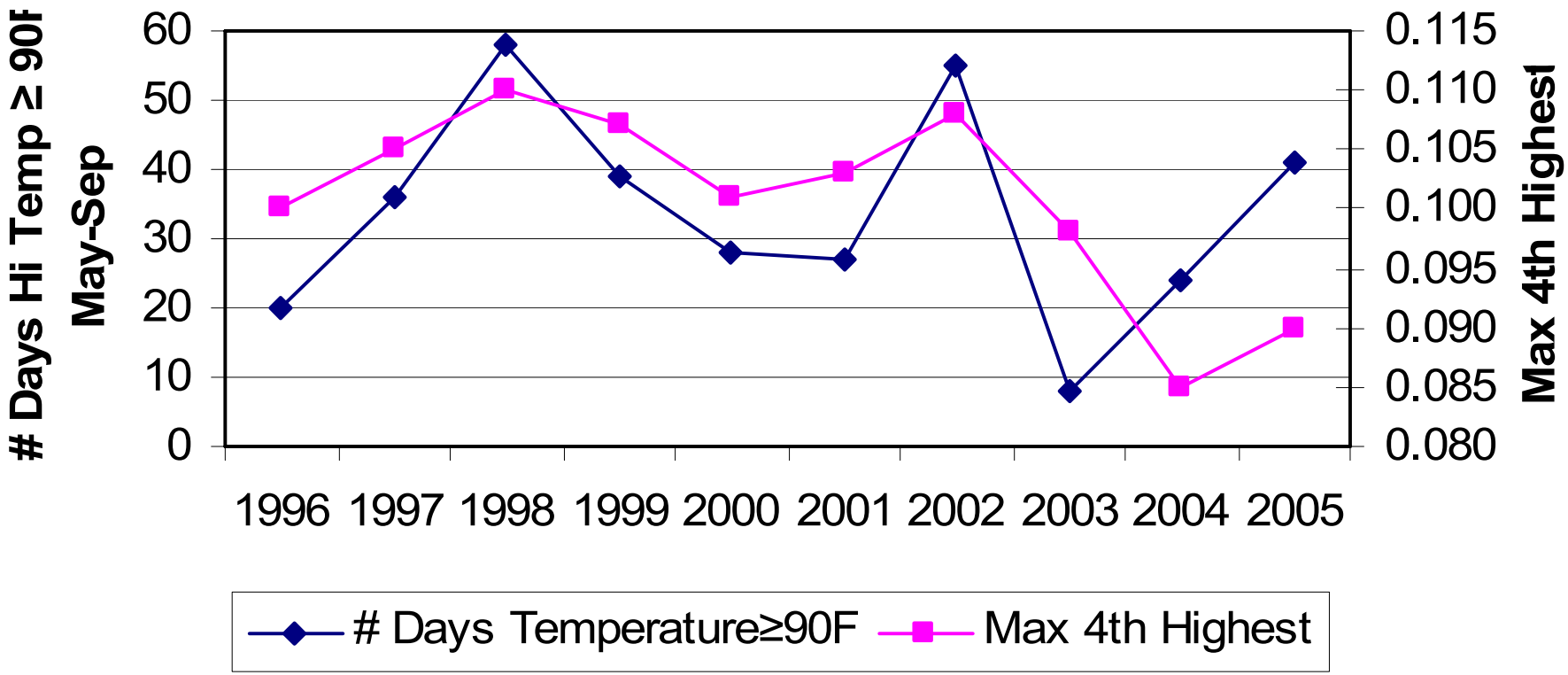
Temps vs. Exceedances

- The next 2 slides show number of days ≥ 90°F compared to number of exceedance days and the maximum 4th highest value in the area.
  - Can see that in years when there were 40 or more days with high temps ≥ 90°F that there were more than 30 exceedance days per year except for 2005 when only 11 exceedance days occurred.
  - When looking at the the maximum 4th highest ozone value in the area compared to temperature, it is even more telling with the maximums being well over 100 ppb when there were more than 40 days with high temps ≥ 90°F compared to 2005 where the max 4th highest 8-hour ozone value was 90 ppb
- This demonstrates that NOx reductions that have occurred since 2002 have resulted in real reductions in ozone.

Temps vs. Exceedances



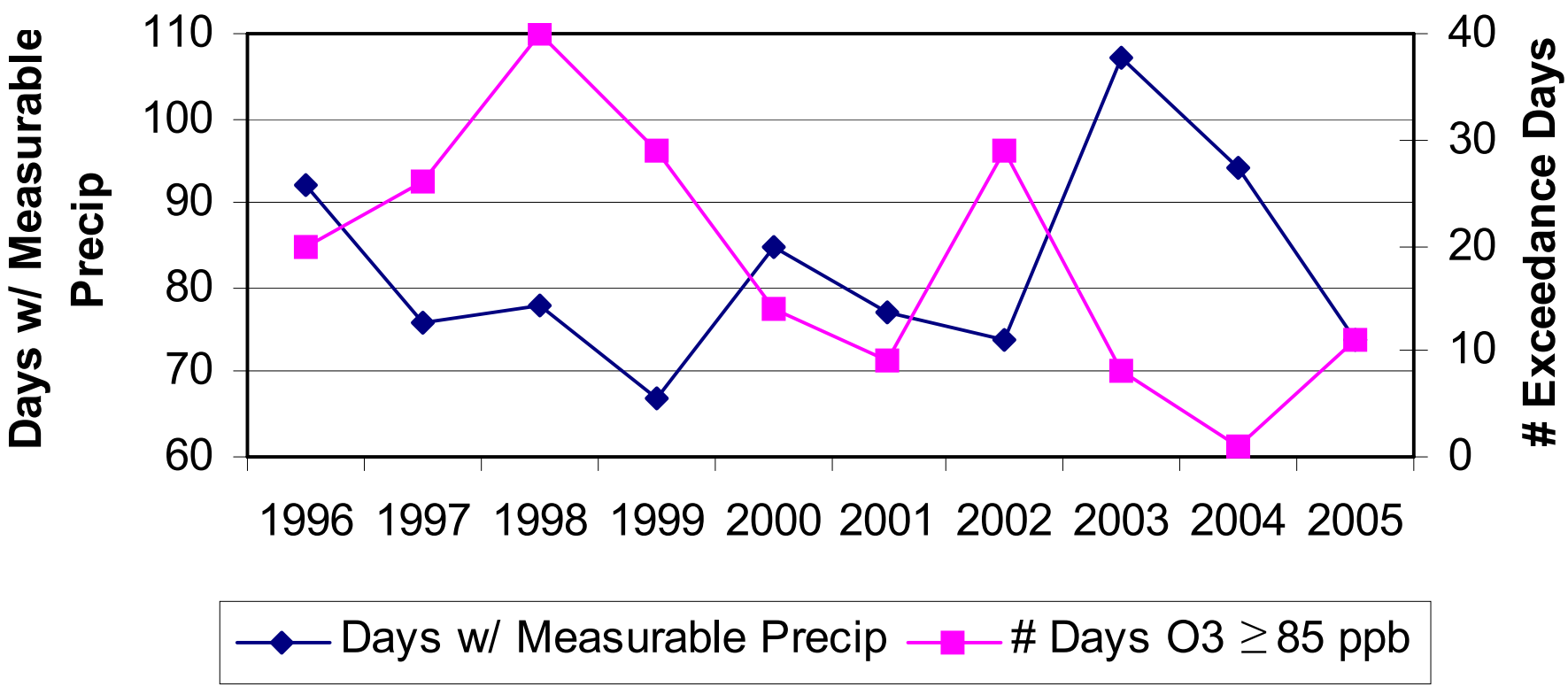
Temps vs. Exceedances



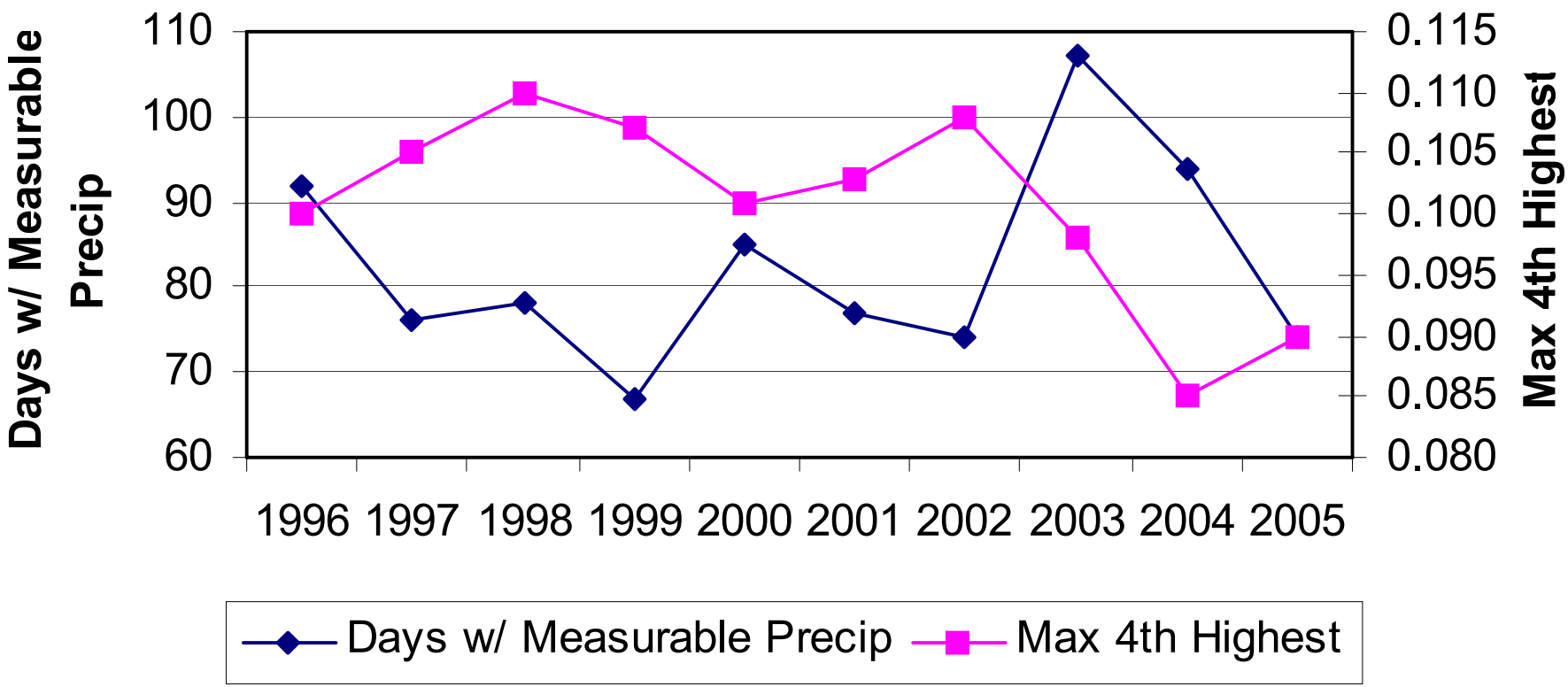
Precipitation vs Exceedances

- The next 2 slides show number of days with measurable precipitaion compared to number of exceedance days and the maximum 4th highest 8-hr ozone value in the area.
  - Can see that in years when there were fewer than 80 days with measurable precipitation, in general there were more than 25 exceedance days per year except for 2005 when only 11 exceedance days occurred.
  - When looking at the the maximum 4th highest ozone value in the area compared to precipitation, it is even more telling with the maximums over 100 ppb when fewer than 80 days with measurable precipitation compared to 2005 where the max 4th highest 8-hour ozone value was 90 ppb
  - The year most comparable to 2005 was 2002 where there were 74 days with measurable precip. The max 4th highest value for 2002 was 108 ppb compared to 90 ppb in 2005

Precipitation vs Exceedances



Precipitation vs Exceedances



Additional Observational Analyses

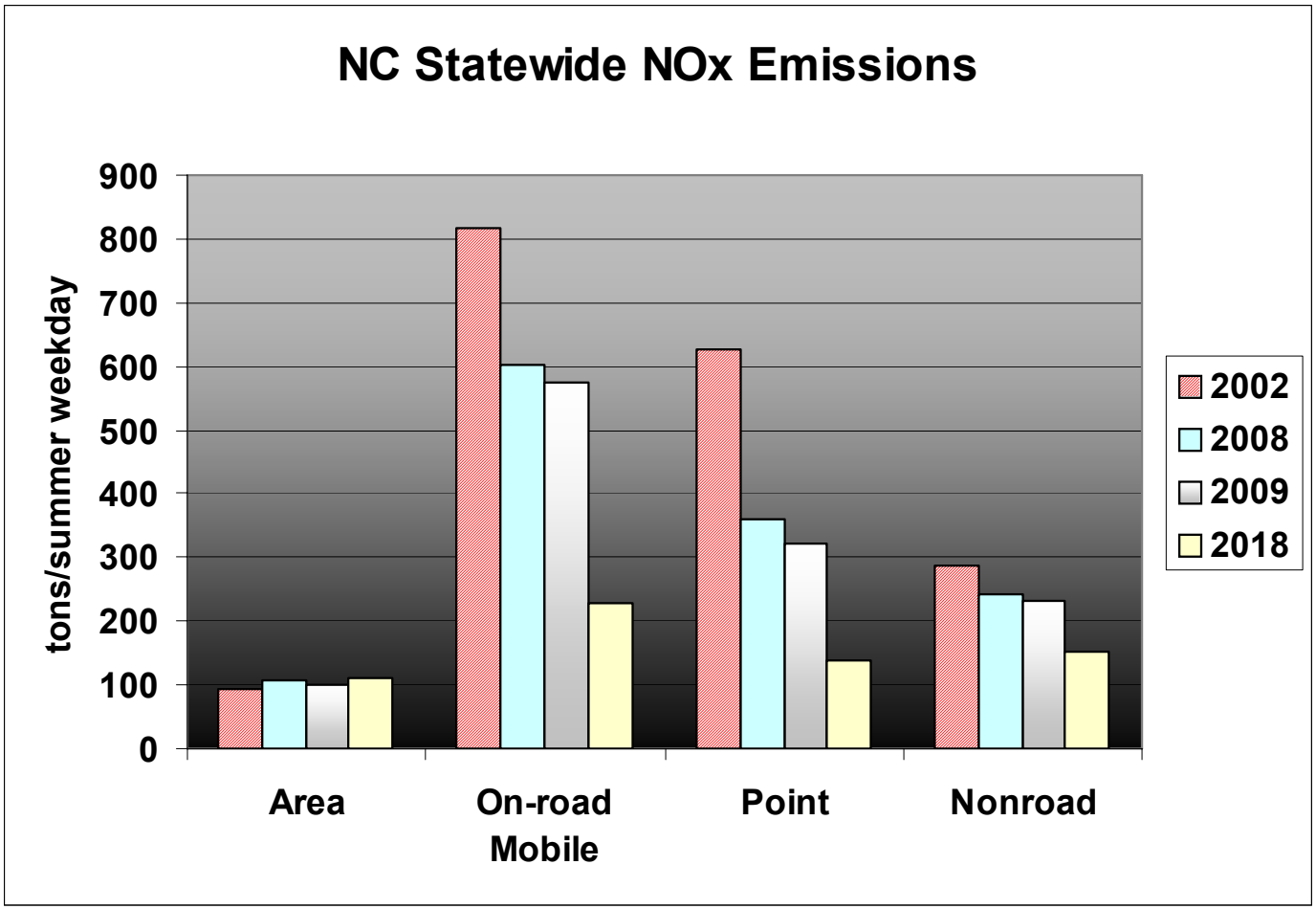
Cox and Chu

- Uses a probability distribution of meteorological severity based on climatological data

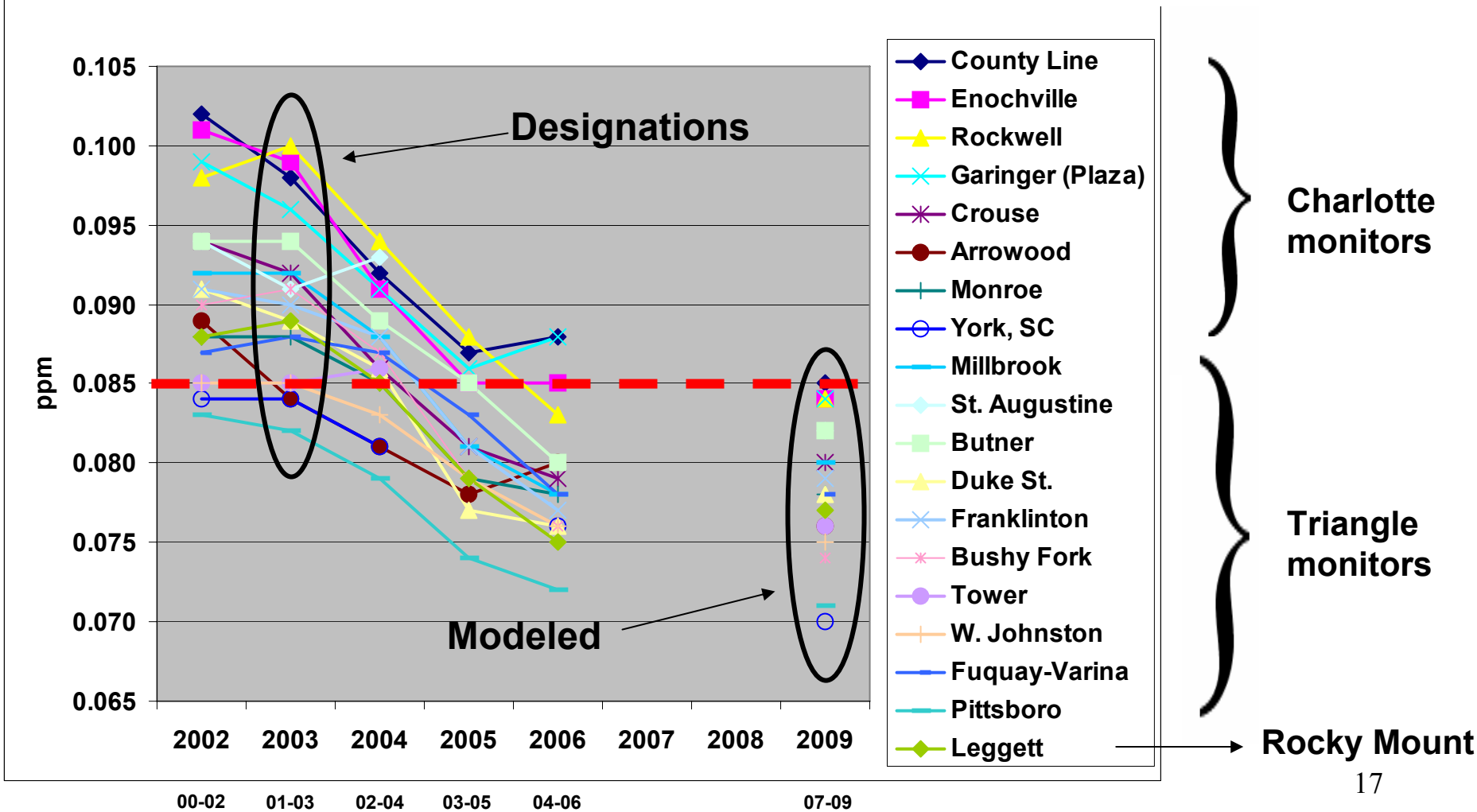
Emissions Analysis

2002, 2008, 2009 and 2018 Emissions Comparison

North Carolina Statewide NOx Emissions



Past, Present and Future 8-hour Ozone Design Values



Close to attaining now and significant NOx reductions yet to come…

…Prior to 2009 ozone season

- Allen Steam Station (Gaston County)
  - 2 units to get SNCR controls installed
    - ~300 tons NOx per ozone season reduced
- Buck (Rowan County)
  - All 4 units still to be controled
    - ~350 tons NOx per ozone season reduced
- Marshall Steam Station (Catawba County)
  - 2 units to get SNCR controls, 1 unit SCR
    - ~2,300 tons NOx per ozone season reduced
- Riverbend (Gaston County)
  - All 4 units to get SNCR controls
    - ~325 tons NOx per ozone season reduced

Close to attaining now and significant NOx reductions yet to come…

…Prior to 2009 ozone season

- In the Charlotte nonattainment area, NCDAQ has estimated that NOx from mobile sources (on-road plus off-road) will be reduced by approximately 8.5 tons per year through 2009.

Overgrown 2009 emissions?

- USEPA draft "working paper" shows a disconnect between emissions forecasts for certain non-EGU sources and the historical record
- Forecasts have typically shown non-EGU emissions going up with time, while actual emissions have gone down with time.
- Thus, many previous non-EGU emissions forecasts have been significantly over-predicted
- Impacts of equipment and fuel replacements/upgrades were not properly considered.

- Have we modeled 2009 with overgrown non-EGU emissions???

Overgrown 2009 emissions?

Weight of Evidence Metric Idea!!!

- Recalculate 2009 non-EGU NOx emissions without using economic activity (follow USEPA's "interim approach")
- Present the difference in the projections as a weight of evidence metric… Depending on your make up of sources, this may be a meaningful metric

2009 modeled non-EGU NOx minus the 2009 non-EGU NOx emissions without econ activity

For more information on the USEPA Draft Working Paper, see:

http://www.epa.gov/ttn/ecas/workingpapers/forecasting_emissions_8-4-06_draft_document.pdf

Variations of modeling data

Modeling WOE metrics

Alternative Attainment Test Approaches

- **Alternative DVC Calculations**
  - 3-year DVC centered on 2002 base year
  - 5-year DVC straight average (no weighting)
- **Alternative RRF Calculations**
  - Center grid cell instead of max of "array"
  - Weighting scheme focused on center grid cell in an array with some consideration of the surrounding cells
  - 70 ppb cut off for including days

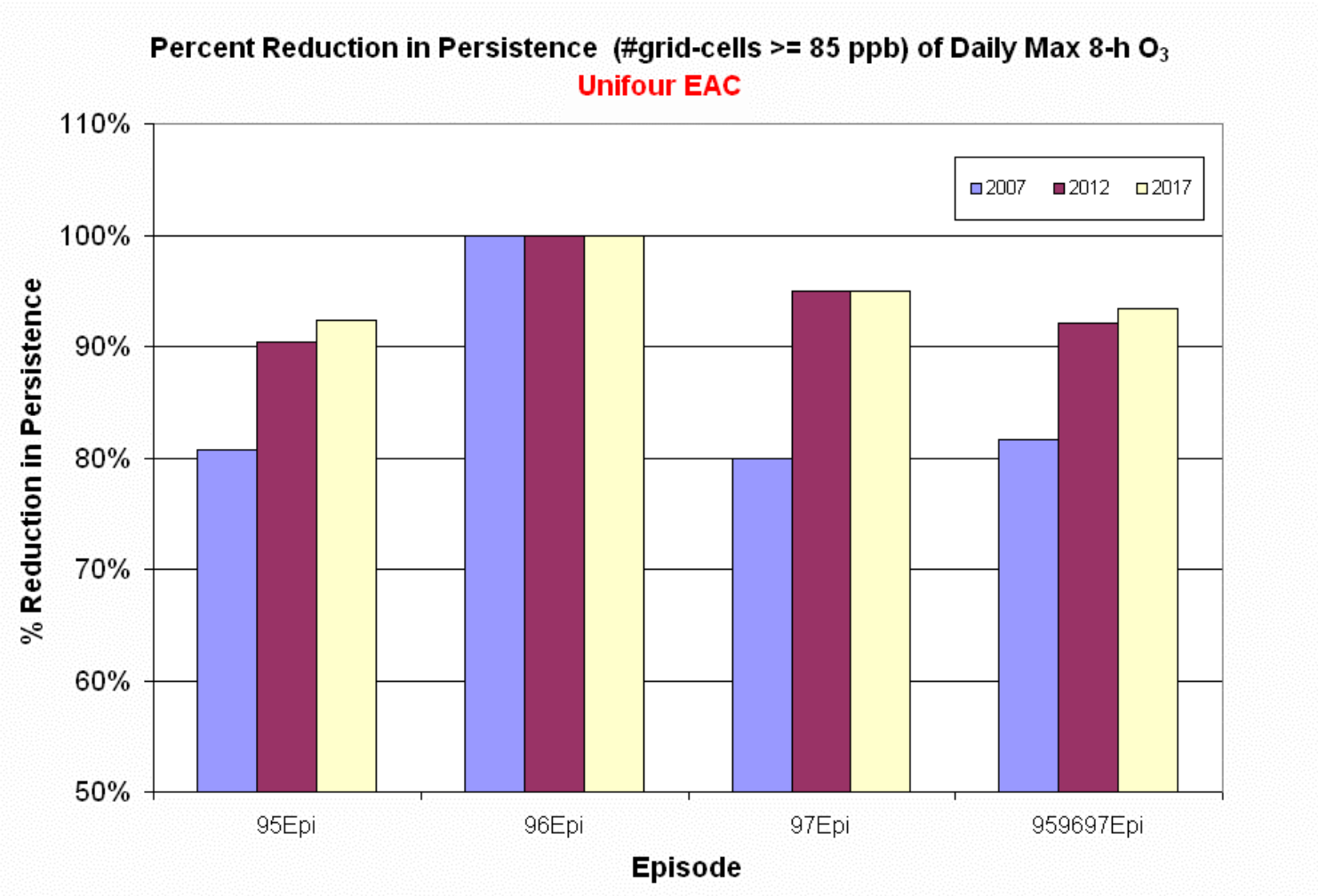
Corroborative WOE Analyses

Modeling WOE metrics

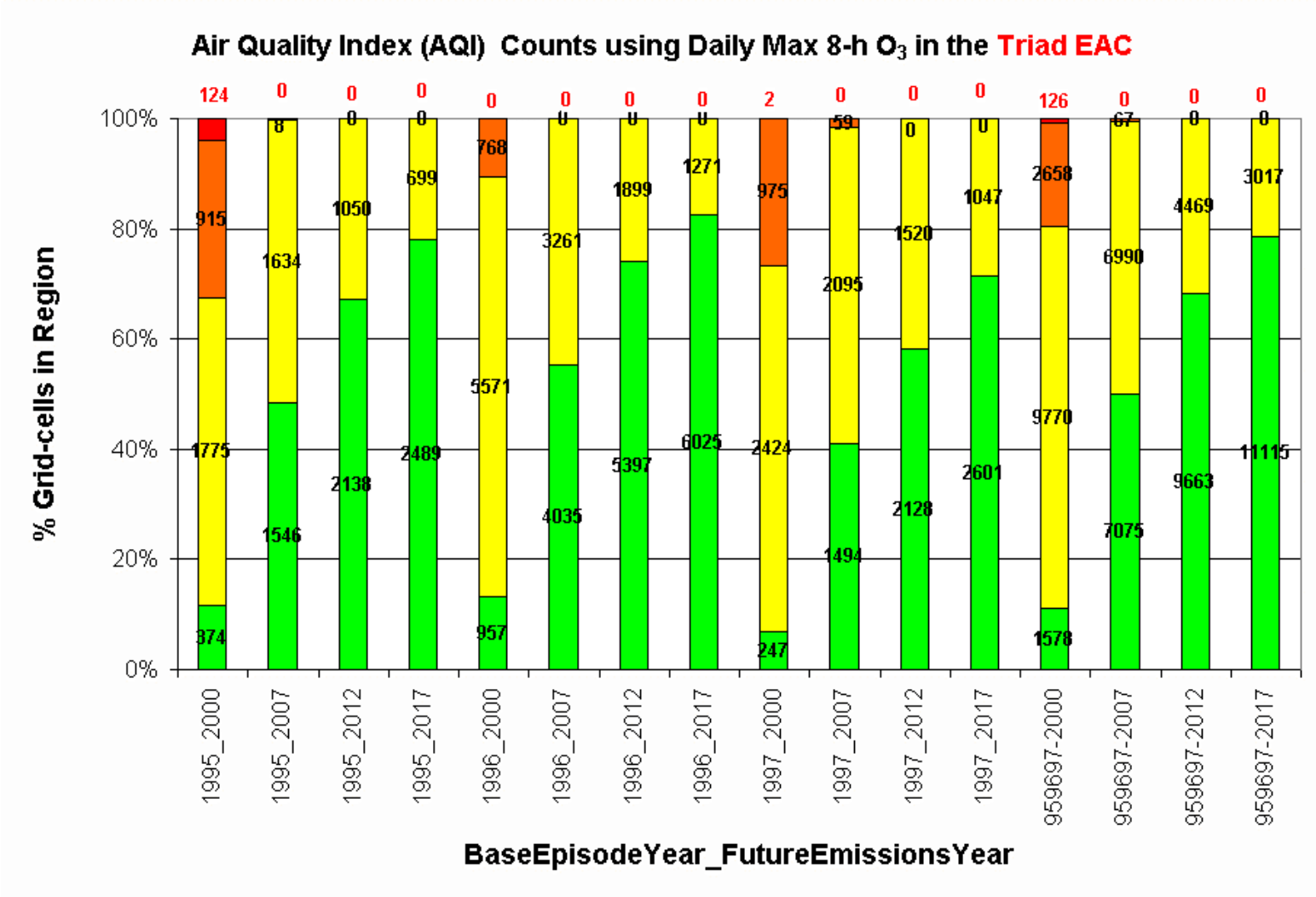
Corroborative WOE Analyses (See USEPA modeling guidance for more information)

- Persistence-Hr (# Grid-hours)
  - Relative diff in hourly 8-hr concentrations
- Persistence-Max (# Grid-hours)
  - Relative diff in max 8-hr concentrations
- Severity-Hr (# Grid-hour-ppb)
- Severity-Max (# Grid-hour-ppb)
- Air Quality Index Counts

Modeling WOE metrics



Modeling WOE metrics



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