



VISTAS Special Monitoring Studies

Continuous Measures of Speciated PM_{2.5}

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Presentation Objectives

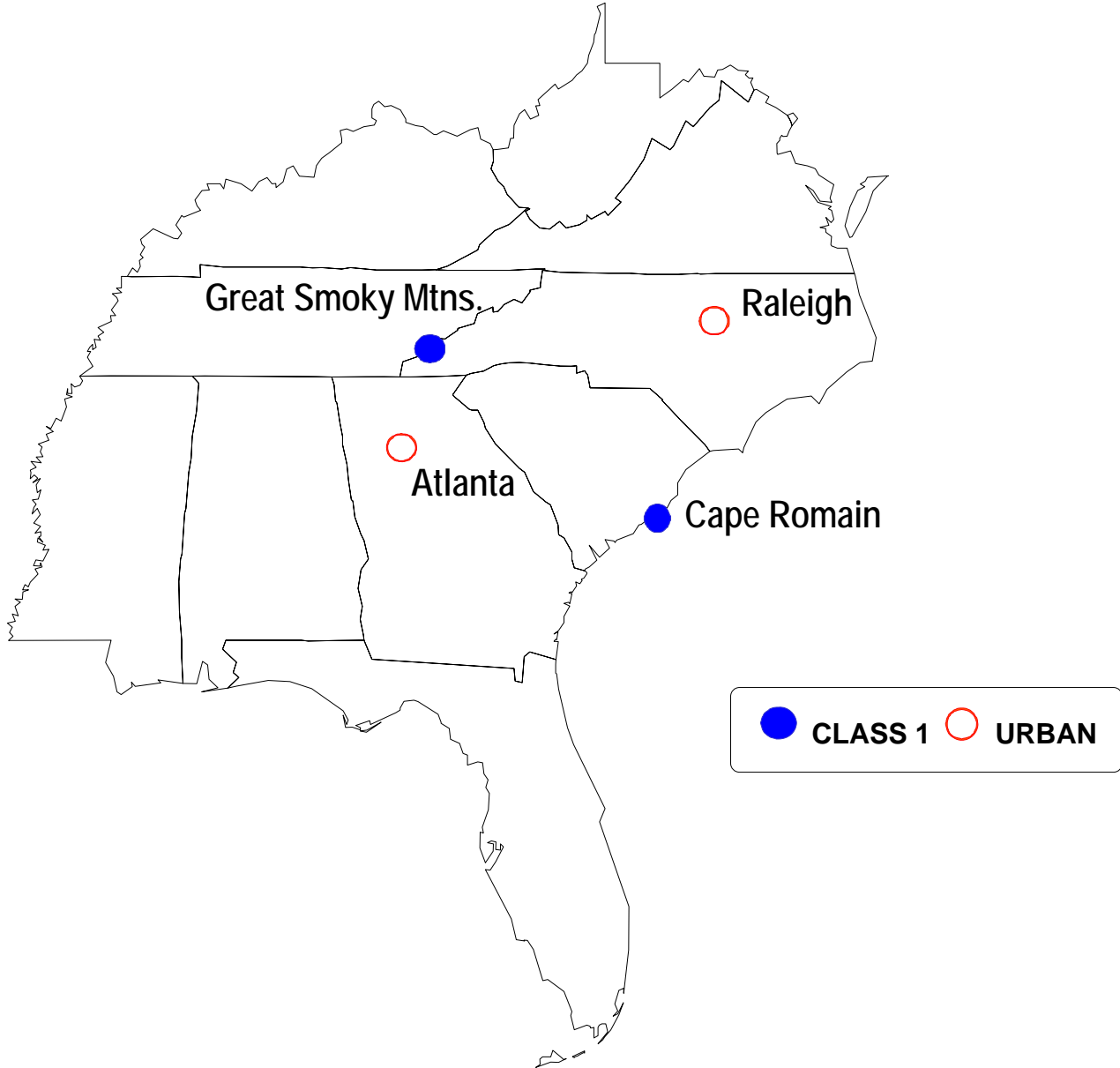
- Special Monitoring Studies
 - Continuous Monitors: PM_{2.5}, Sulfate, Nitrate, Total Carbon, Black Carbon



Monitoring Objectives

- Use continuous monitors of PM_{2.5} mass, sulfate, nitrate, total carbon and black carbon to characterize daily and spatial trends
 - Data collected Mar 2003 - Dec 2004
 - Raw data available in AQS
 - Normalized data available from VISTAS
 - Draft VISTAS Report authored by Roger Tanner, TVA

VISTAS Focus Sites





Focus Sites

March 2003 - December 2004

- Continuous monitoring:
 - Sulfate, Nitrate, Total Carbon (R&P instruments)
 - Black Carbon (Aethalometer)
 - Continuous Mass (TEOM)
 - Precursor gases - SO_2 , NO_y , CO
 - Light Scattering (Nephelometer) at Class 1 areas)
 - Meteorology
 - Alternative Sulfate and Nitrate methods
- Filter-based Speciation: IMPROVE or STN



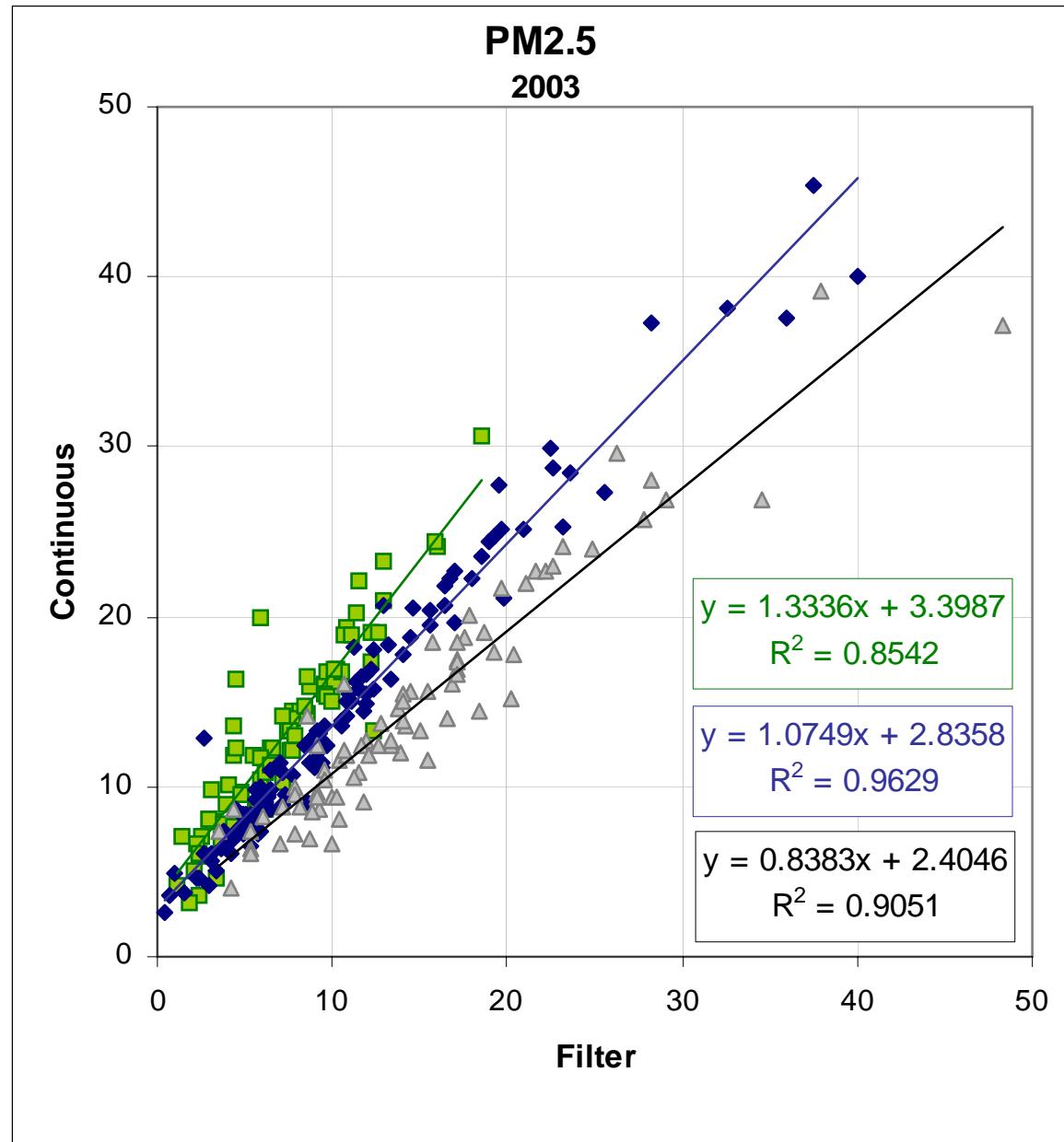
Lessons Learned from Continuous Monitors

- Continuous PM_{2.5} mass (TEOM) shows good agreement to PM_{2.5} mass from filter



Mass

- Cape Romain
- ◆ Look Rock
- ▲ Millbrook



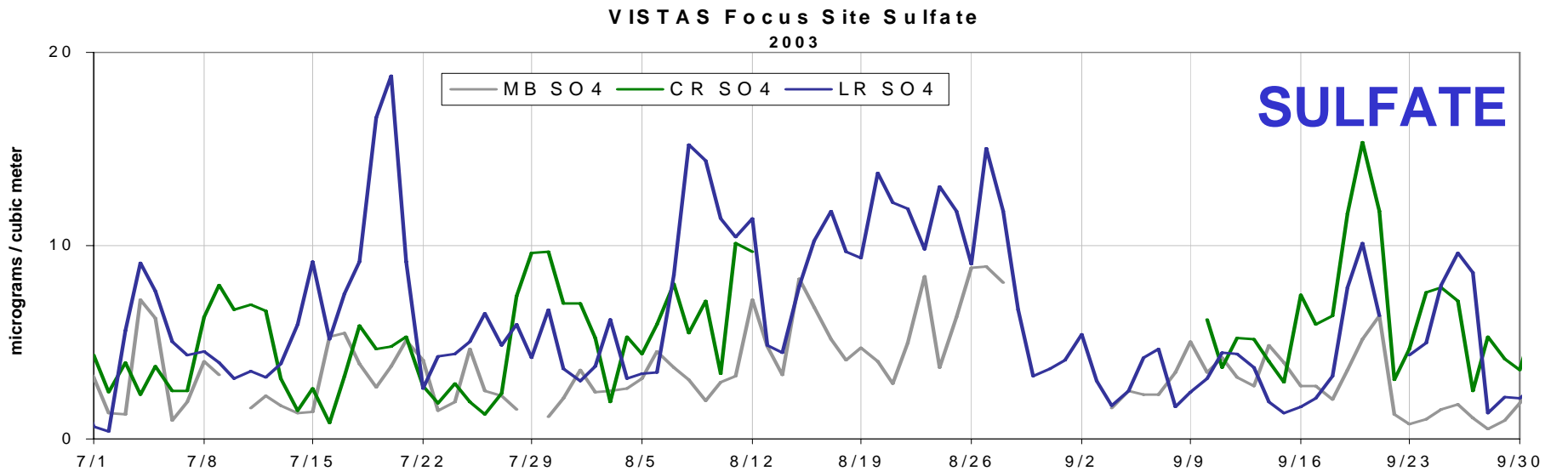
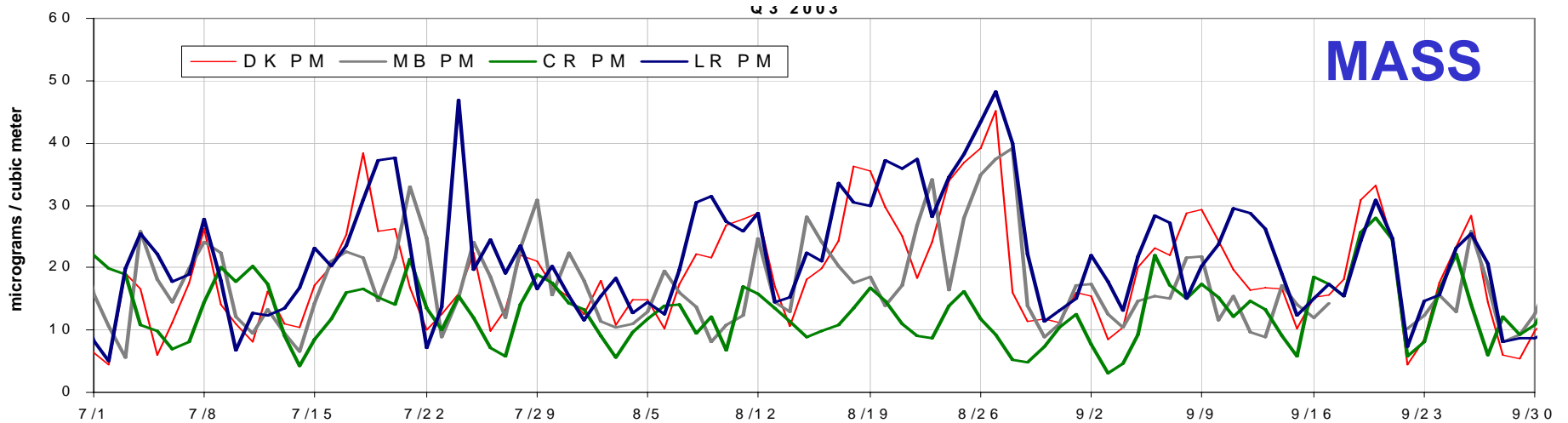
Continuous PM2.5 mass shows good agreement to PM2.5 mass from filter



Lessons Learned from Continuous Monitors

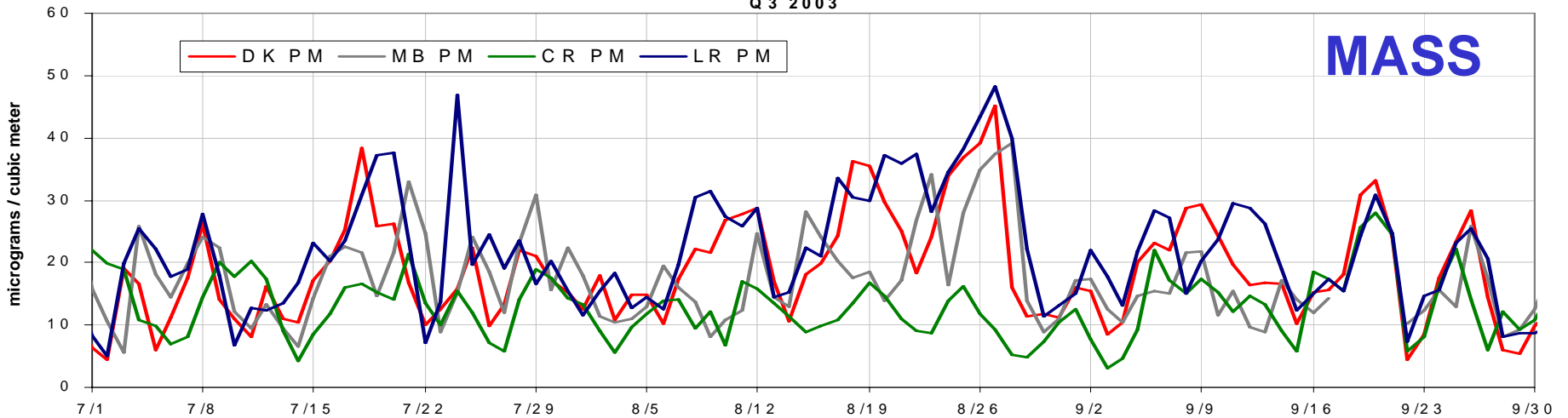
- Aethalometer (BC) has good performance
- R&P instruments for S, N, and Total C achieved good data capture (>75%) when operating
 - Periodic failures R&P instruments
- S, N, TC, BC continuous data needs to be normalized to filter-based data to interpret trends.
 - Correlations by Site and Quarter
- Continuous speciated monitors have high upkeep and data management
 - Postscript: R&P monitors are being discontinued
 - Alternative commercial continuous monitors

Third Quarter 2003

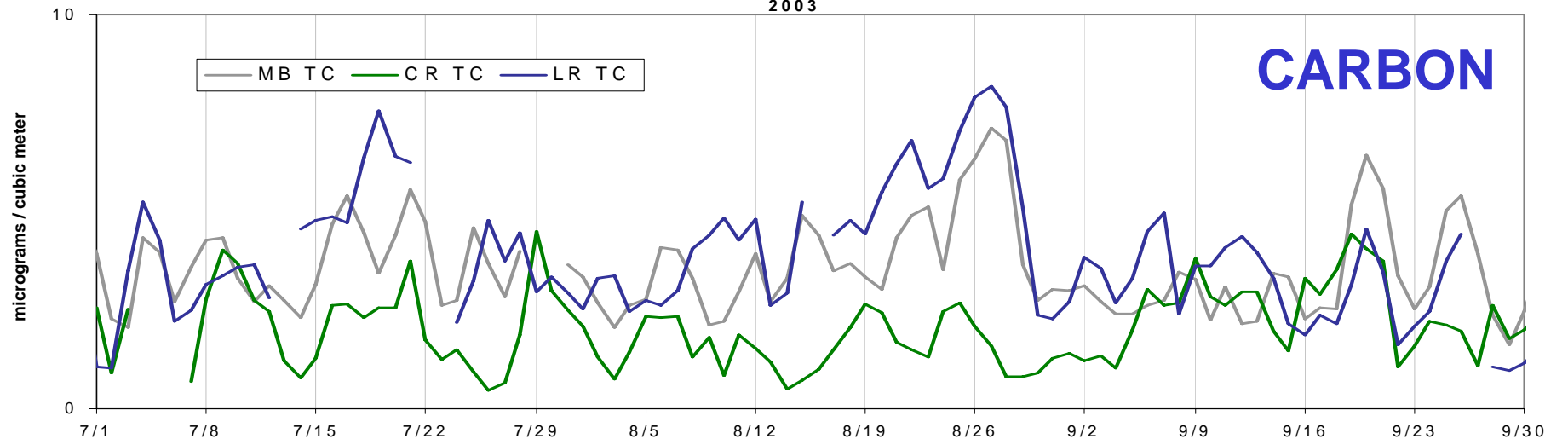


Third Quarter 2003

VISTAS Focus Site TEOM PM_{2.5}
Q3 2003



VISTAS Focus Site Total Carbon
2003





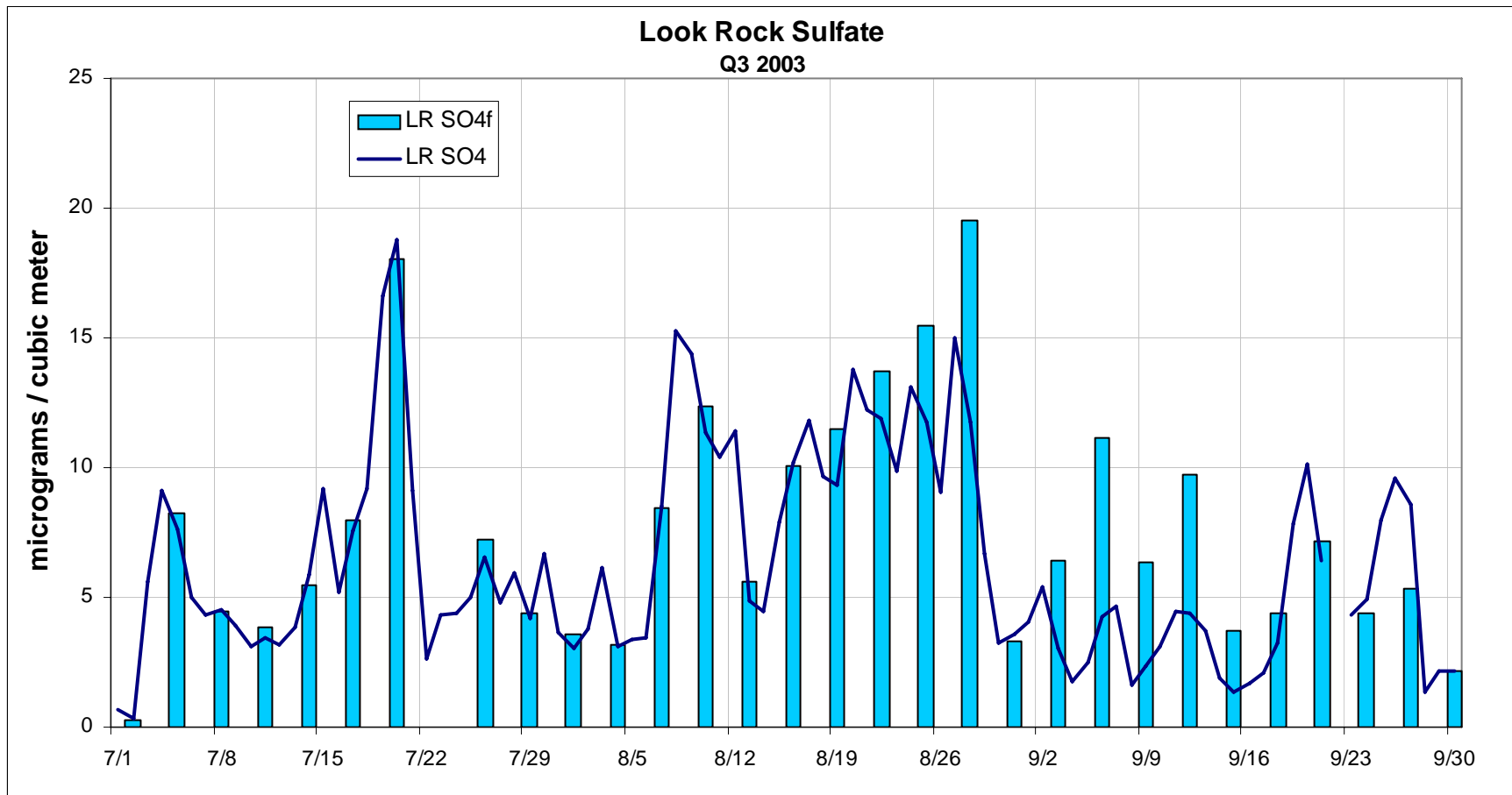
Lessons Learned from Continuous Monitors

- Continuous monitors high scatter compared to filter-based data
- Capture same spatial and seasonal trends as filter-based data



Filter comparisons

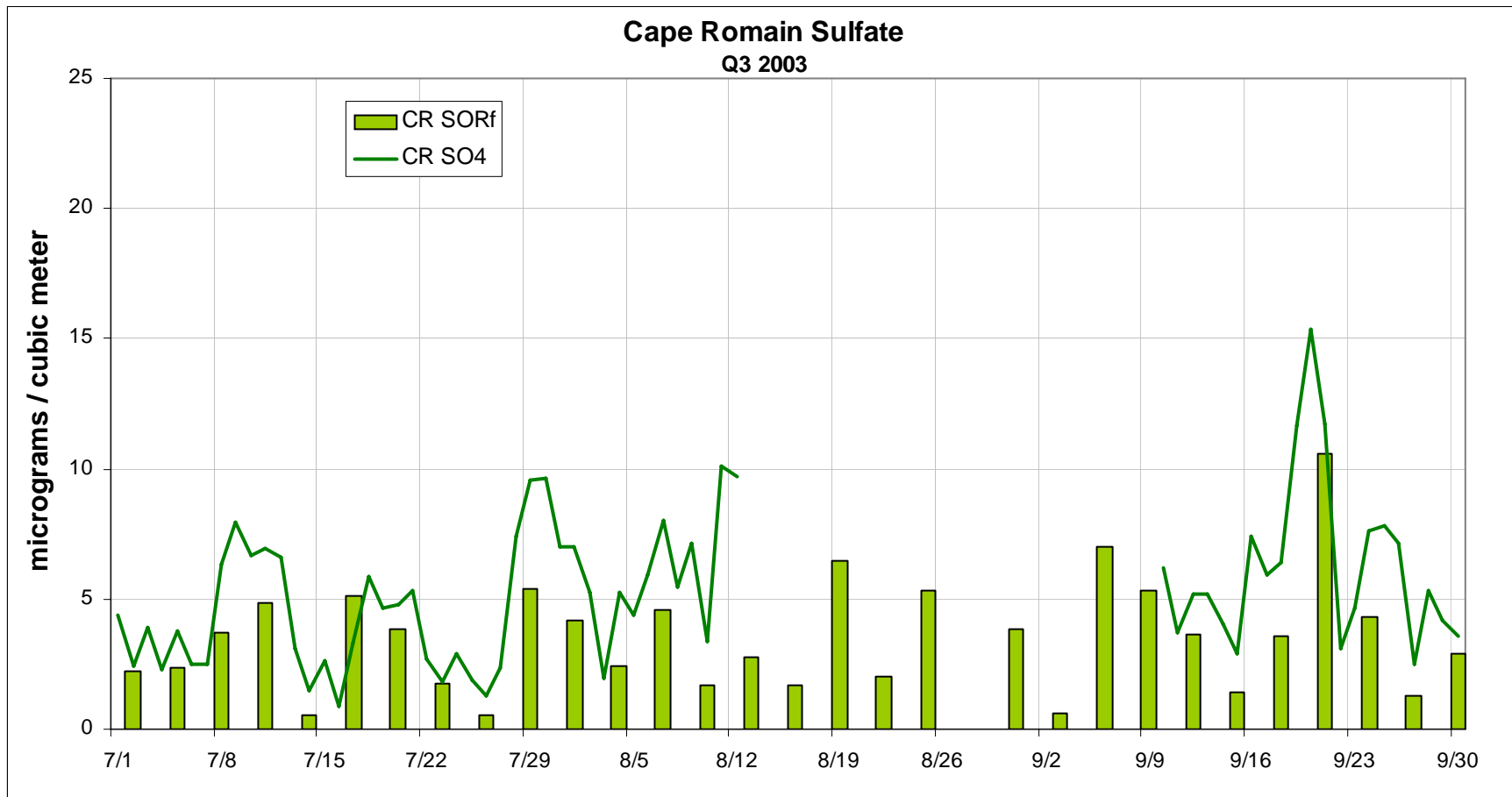
Sulfate - IMPROVE





Filter comparisons

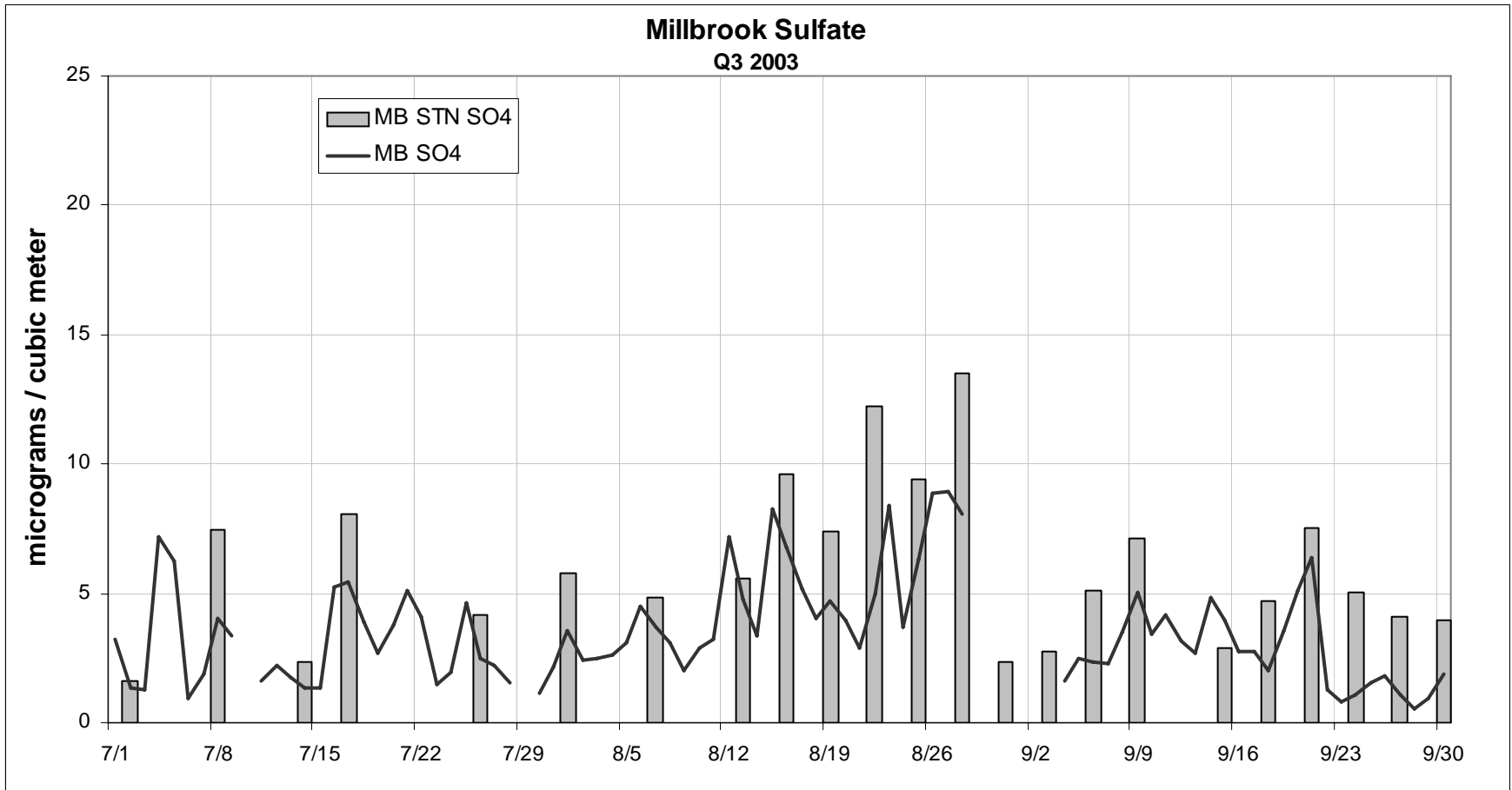
Sulfate - IMPROVE



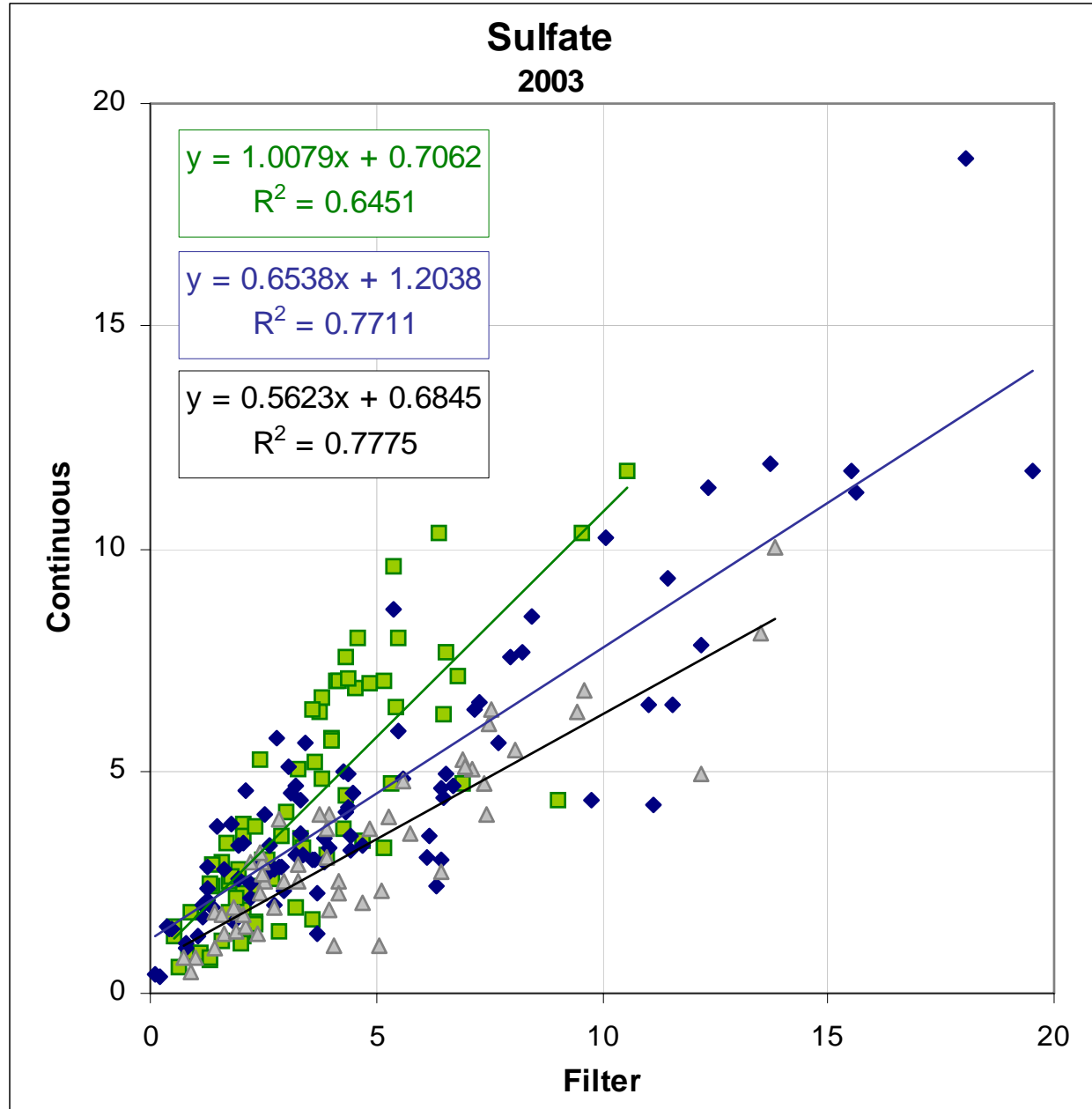


Filter comparisons

Sulfate – STN



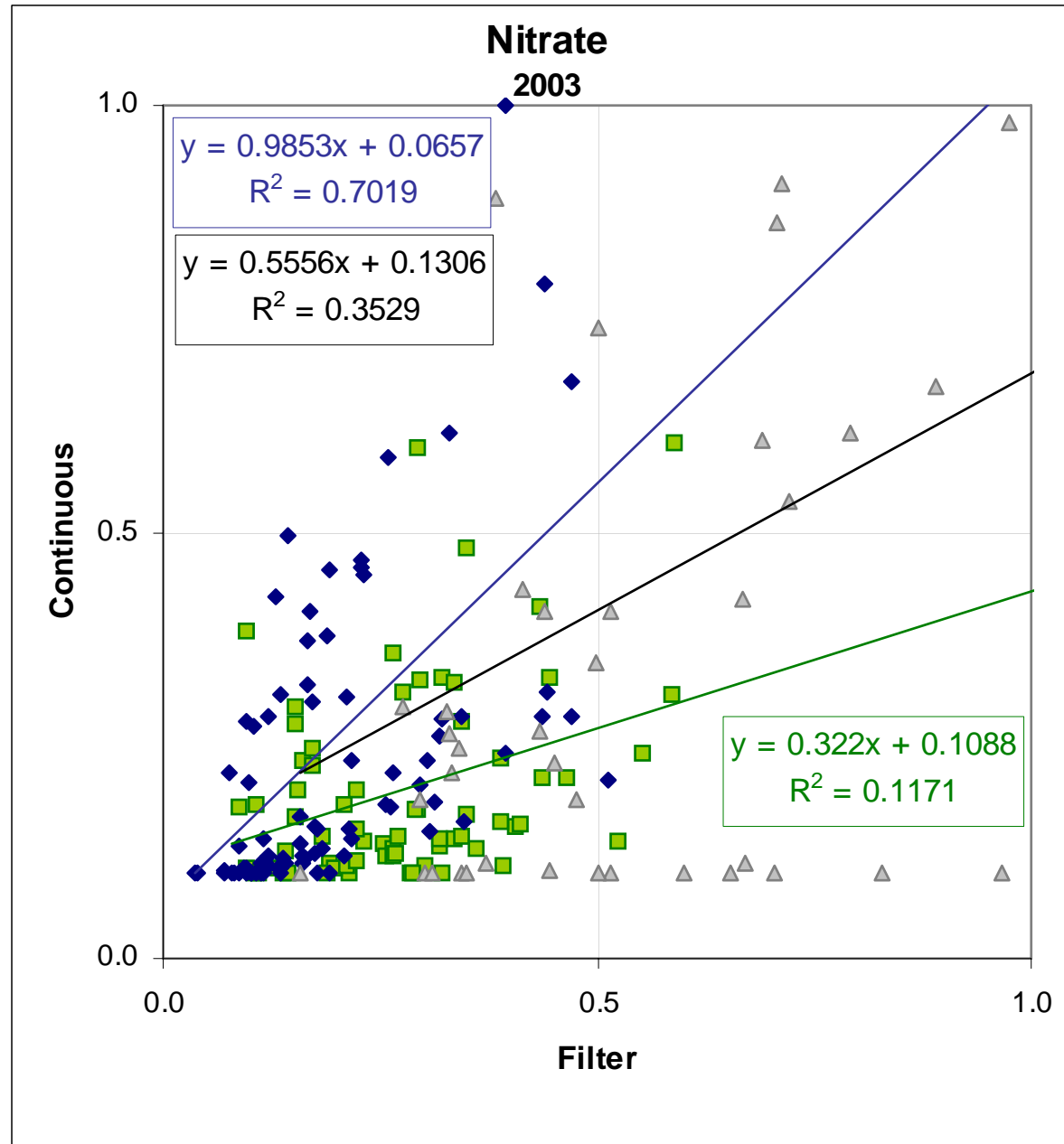
Sulfate



- Cape Romain
- ◆ Look Rock
- ▲ Millbrook



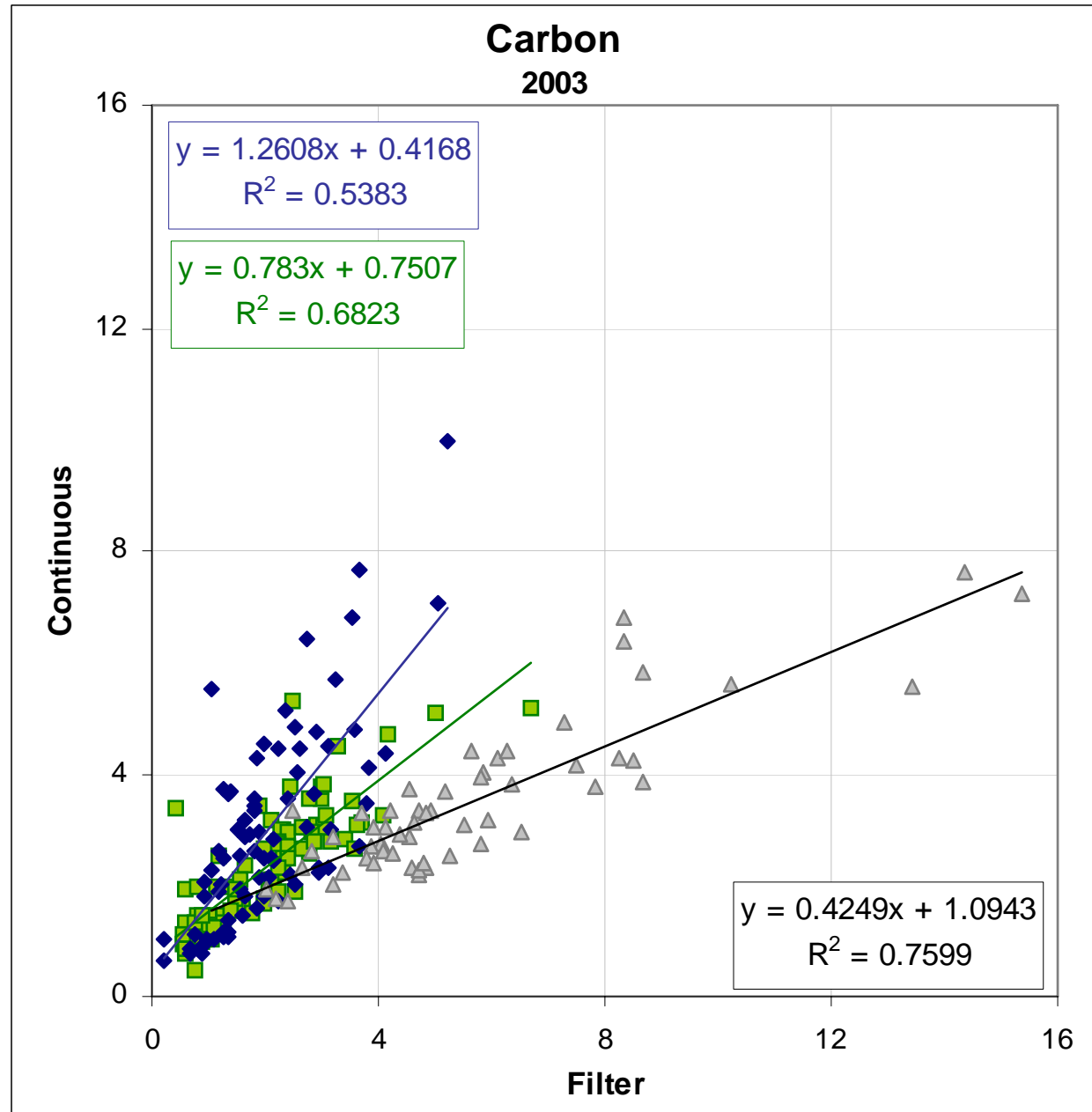
Nitrate





Total Carbon

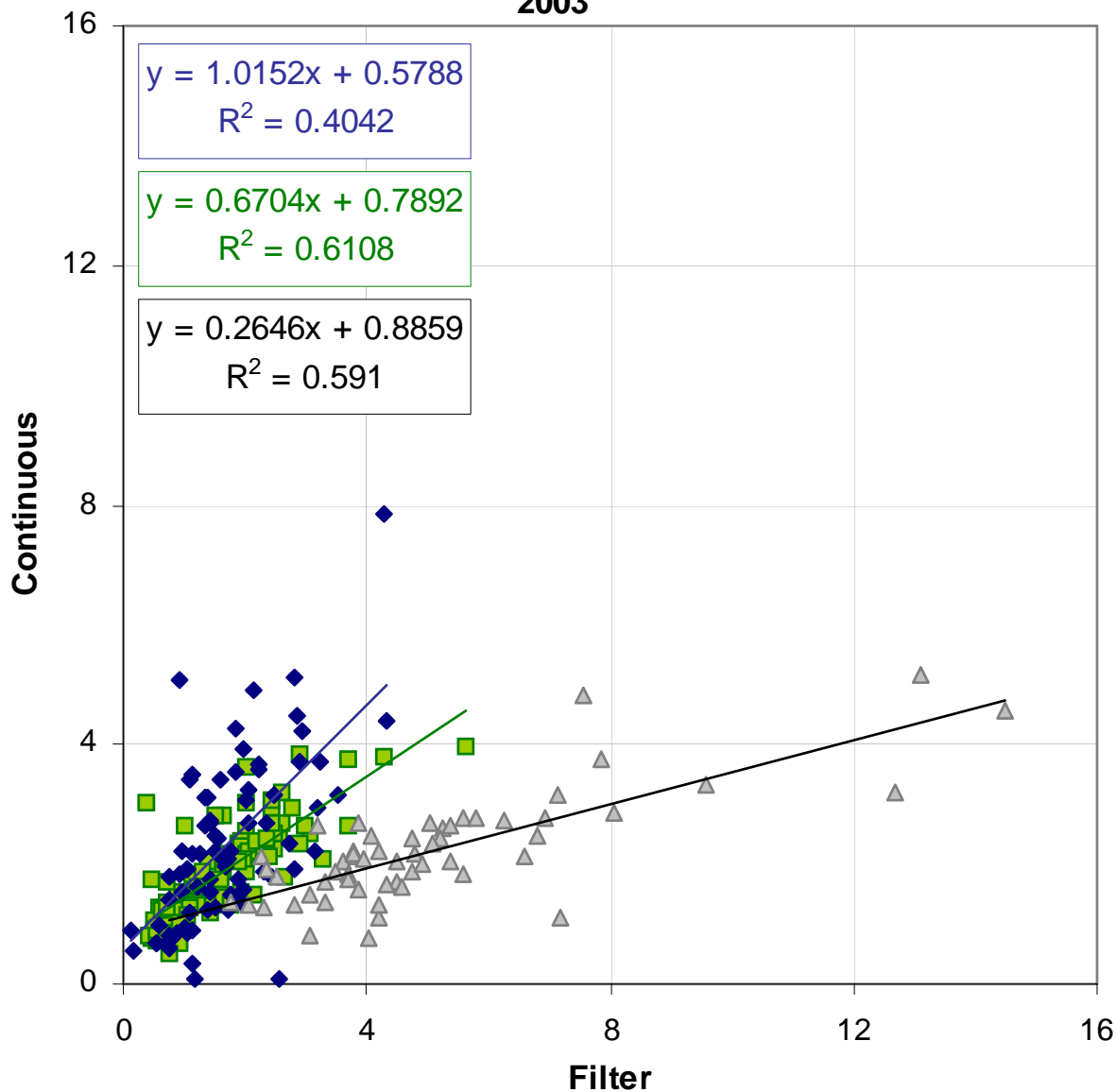
Carbon 2003





Elemental to Black Carbon

Elemental Carbon 2003



- Cape Romain
- ◆ Look Rock
- ▲ Millbrook



Normalizing Continuous Monitoring Data

- Continuous data was normalized to filter data to facilitate comparison to modeled values
 - Regressions calculated for each site, each quarter

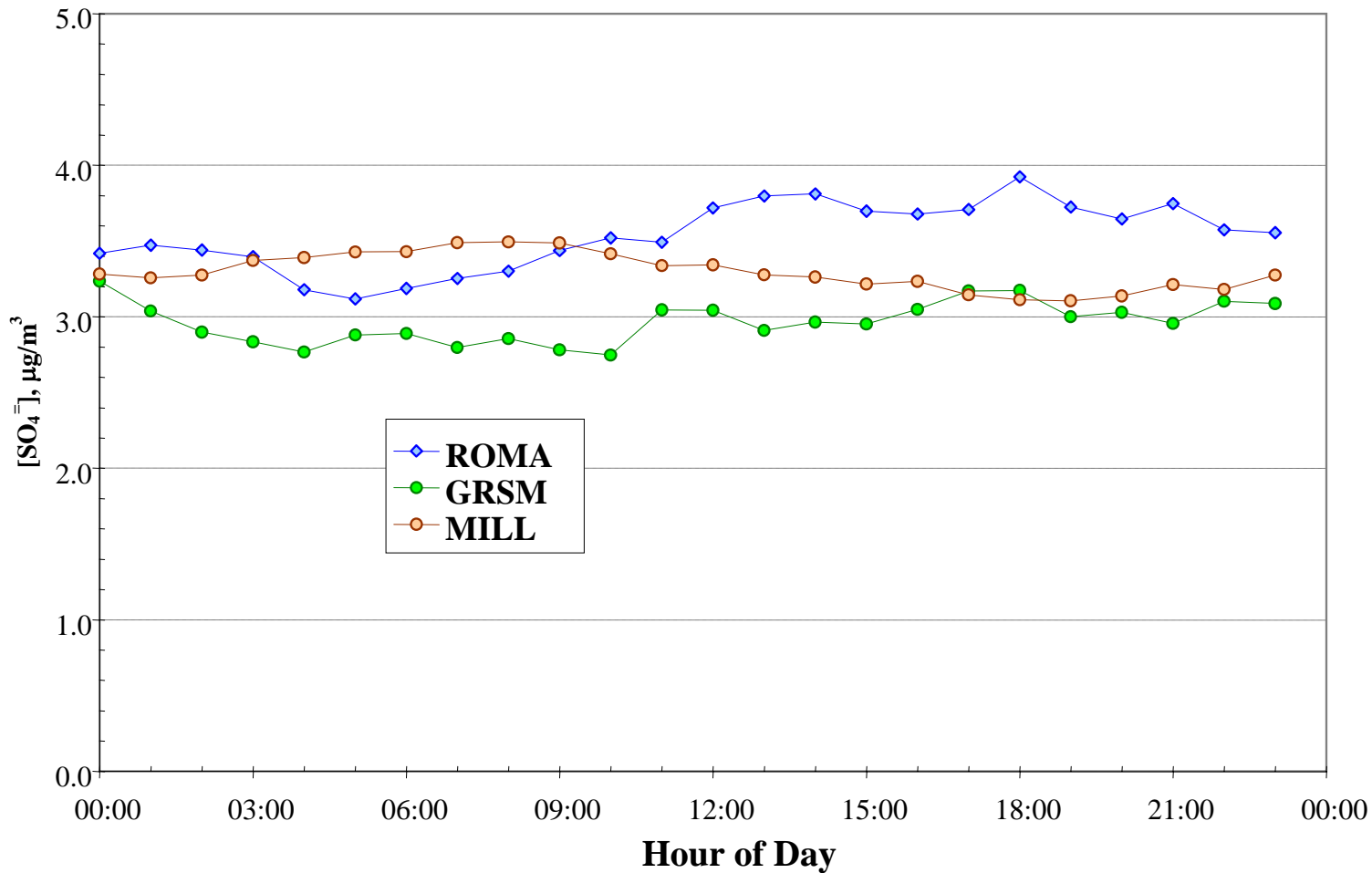


Lessons Learned from Continuous Monitors

- Diurnal and seasonal trends:
 - Sulfate:
 - GRSM > MILL > ROMA in summer
 - Little regional difference other seasons
 - Consistent with regionally distributed sources
 - Highest in summer at all sites
 - Afternoon peak in warm seasons, not other seasons
 - Consistent with photochemical production

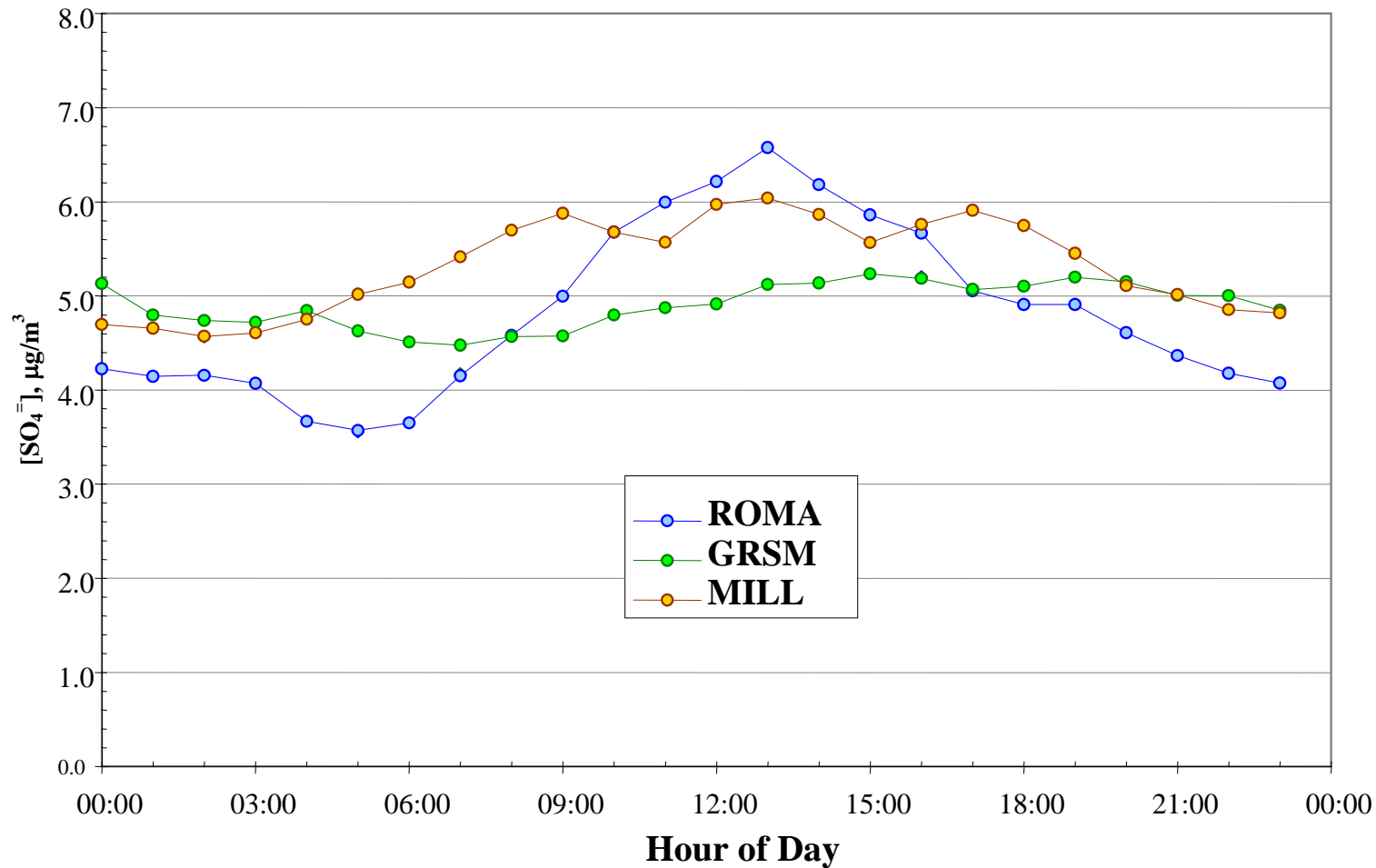


Diurnal Pattern of Average Sulfate in Winter (Jan-Mar) 2004 at Focus Sites



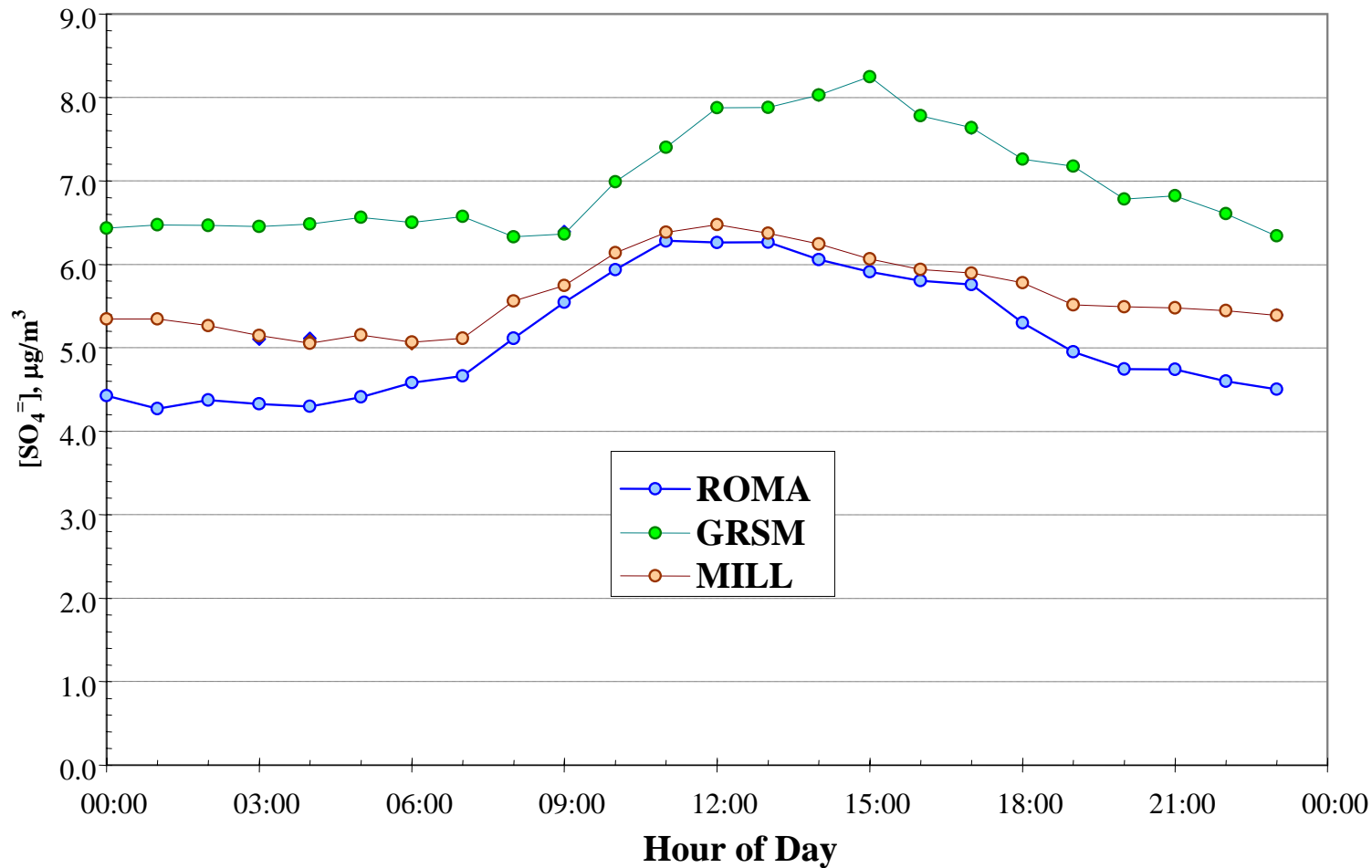


Diurnal Pattern of Average Sulfate in Spring (Apr-Jun) 2004 at Focus Sites



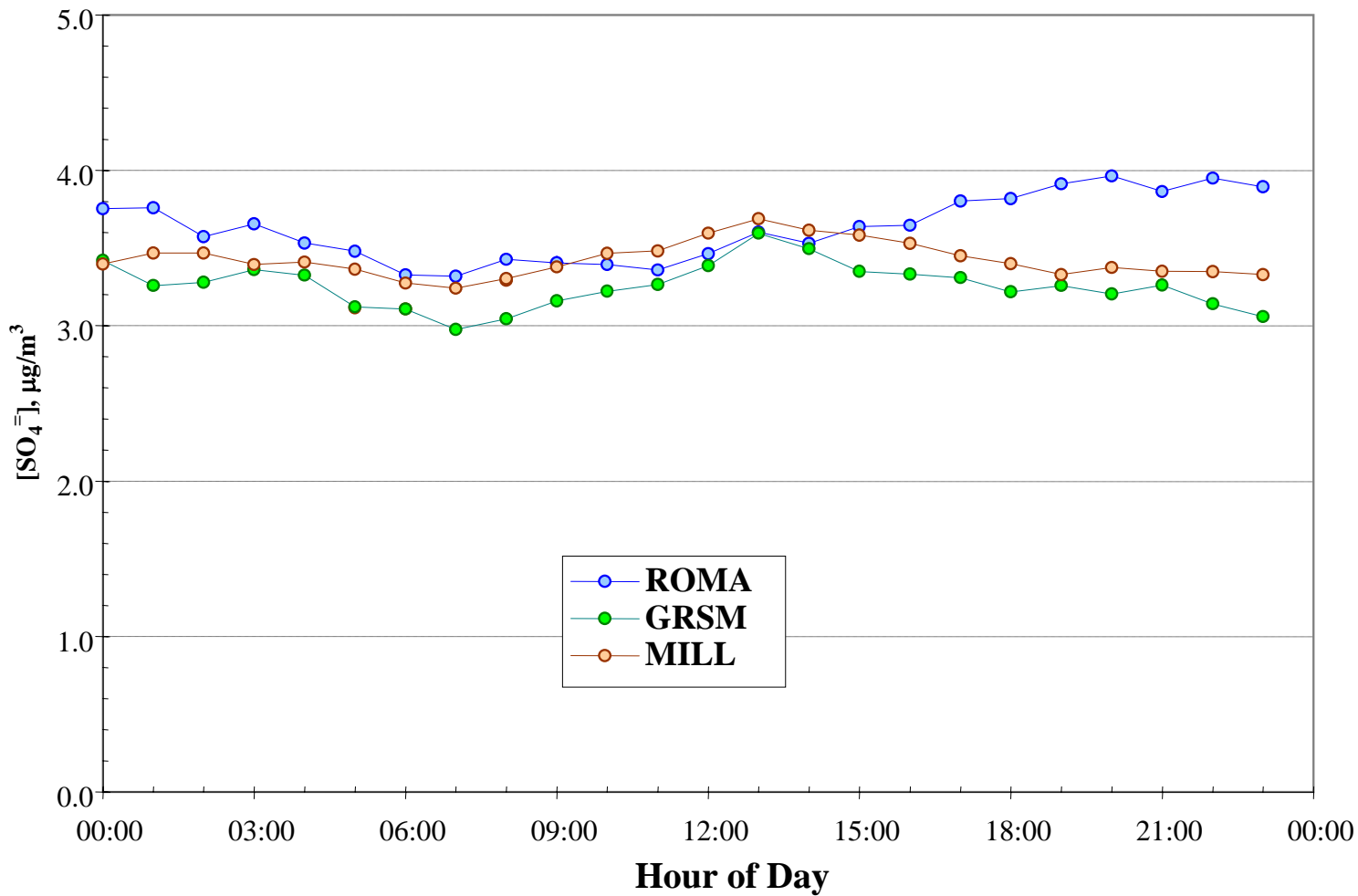


Diurnal Pattern of Average Sulfate in Summer (Jul – Sep) 2004 at Focus Sites





Diurnal Pattern of Average Sulfate in Fall (Oct – Dec) 2004 at Focus Sites



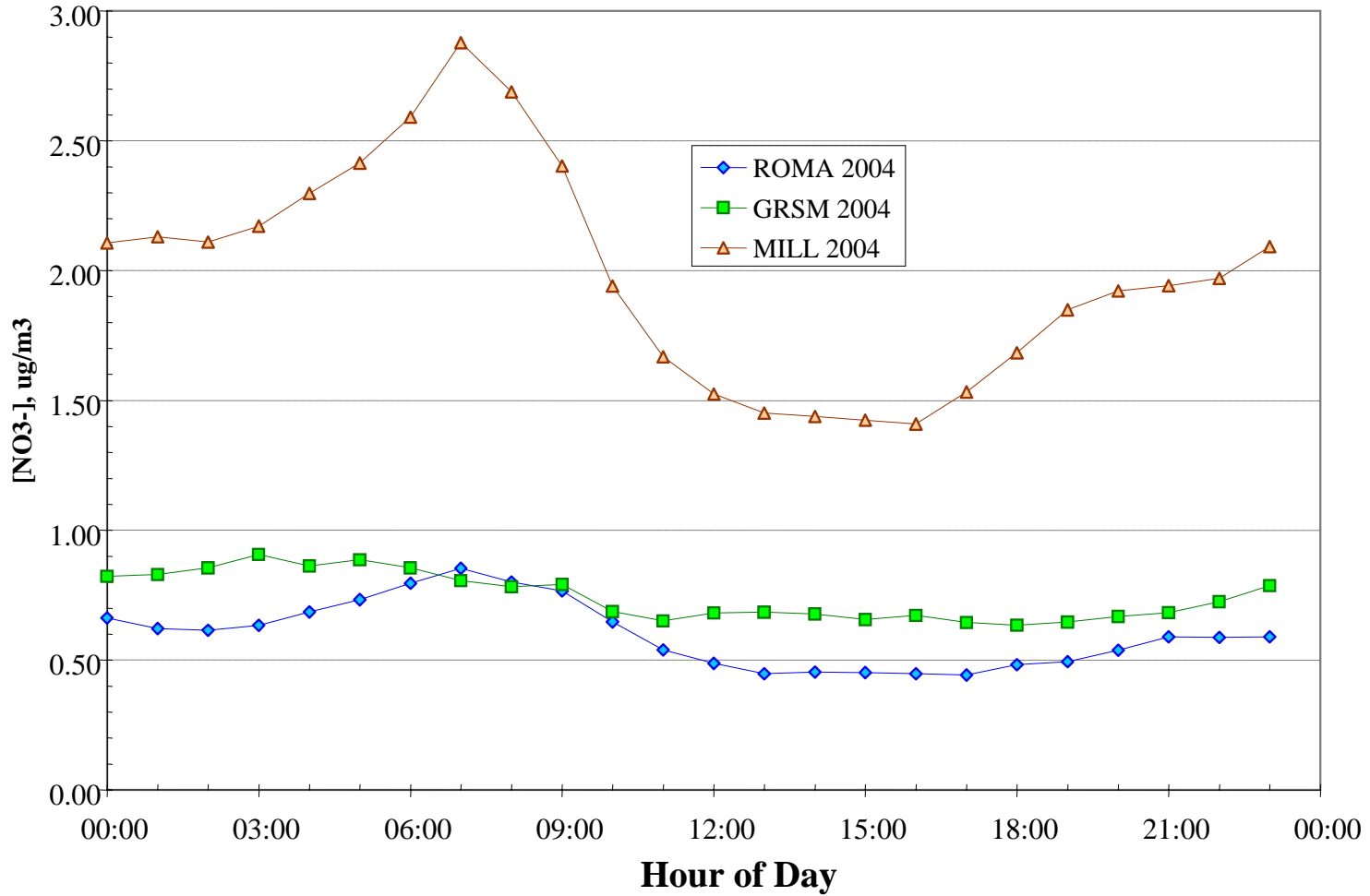


Lessons Learned from Continuous Monitors

- Diurnal and seasonal trends:
 - Nitrate:
 - Highest in winter, lowest in summer
 - Seldom greater than $1 \mu\text{g}/\text{m}^3$ except winter
 - Consistent with temperature dependency
 - MILL > ROMA > GRSM
 - Dawn peak at MILL, before rush hour
 - Consistent with high RH before dawn
 - Local sources

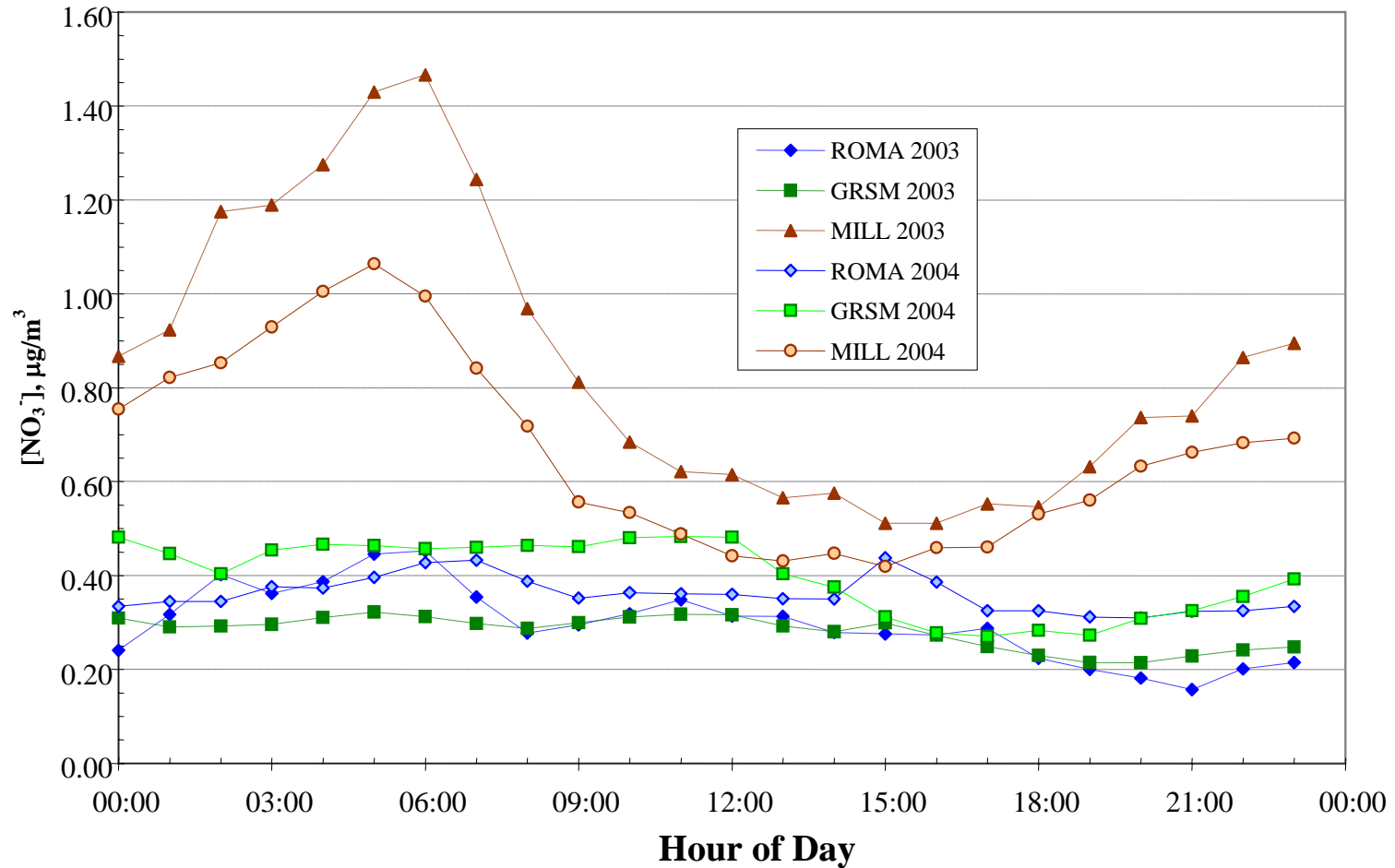


Diurnal Pattern of Average Nitrate in Winter 2004 at Focus Sites



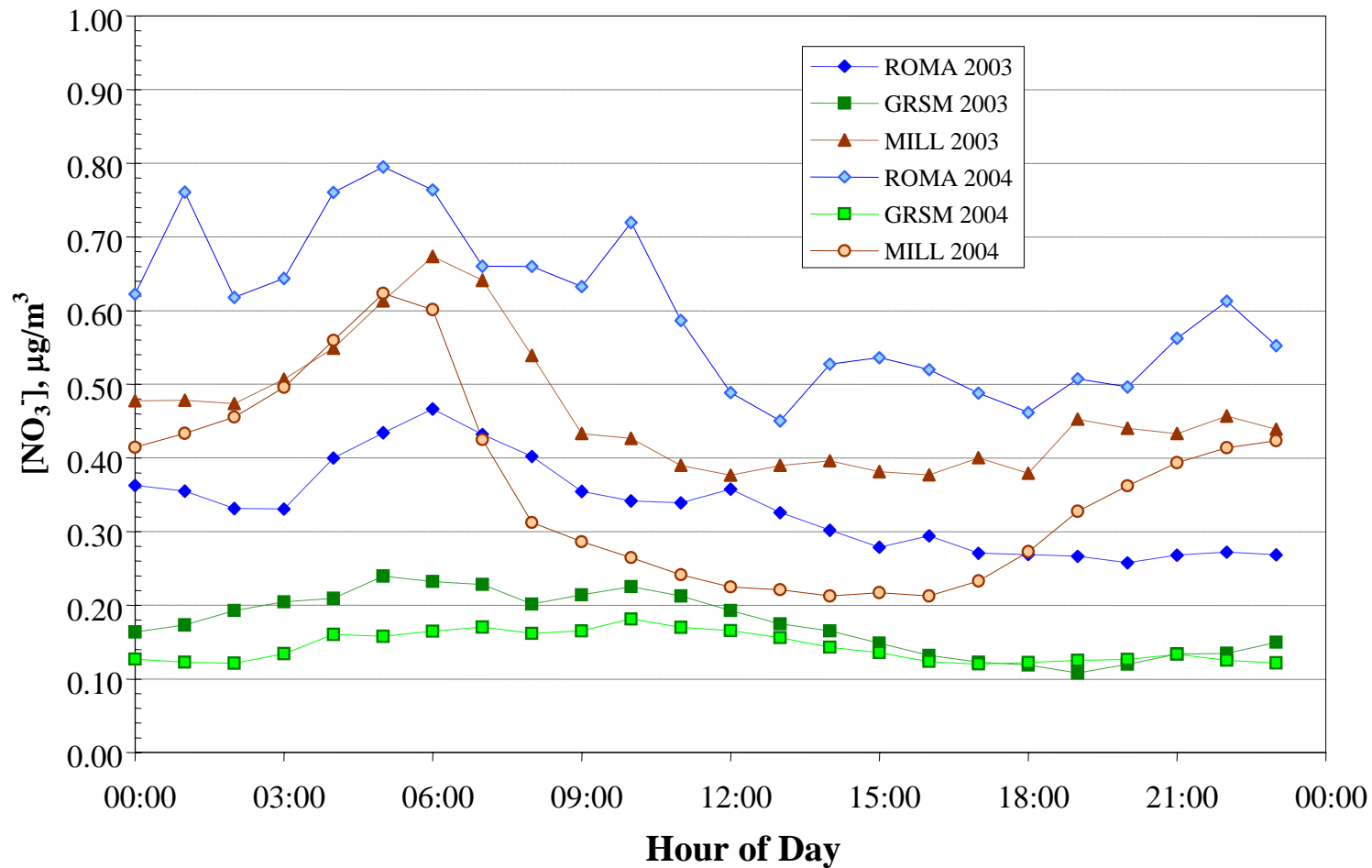


Diurnal Pattern of Average Nitrate in Spring at Focus Sites



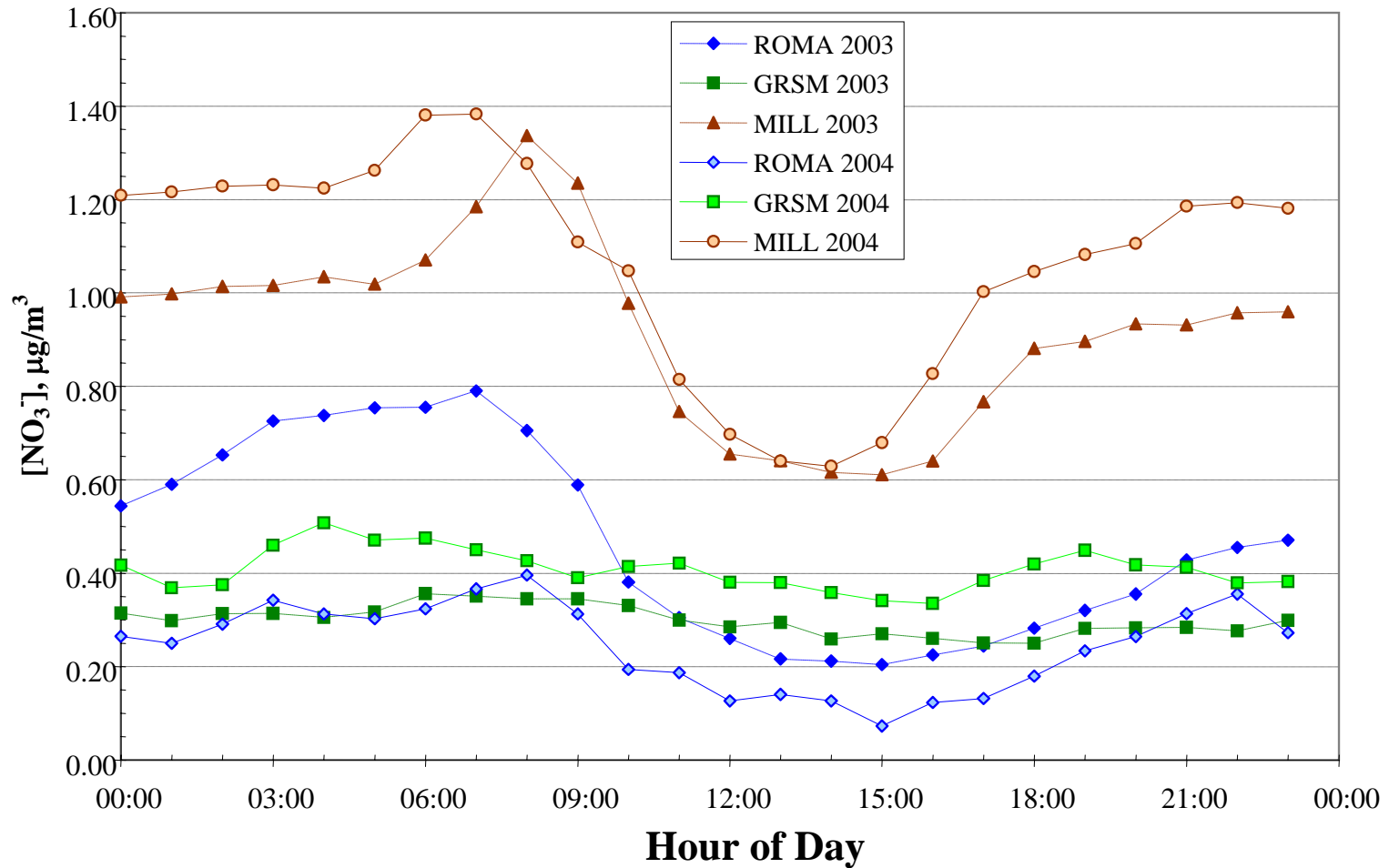


Diurnal Pattern of Average Nitrate in Summer at Focus Sites





Diurnal Pattern of Average Nitrate in Fall at Focus Sites



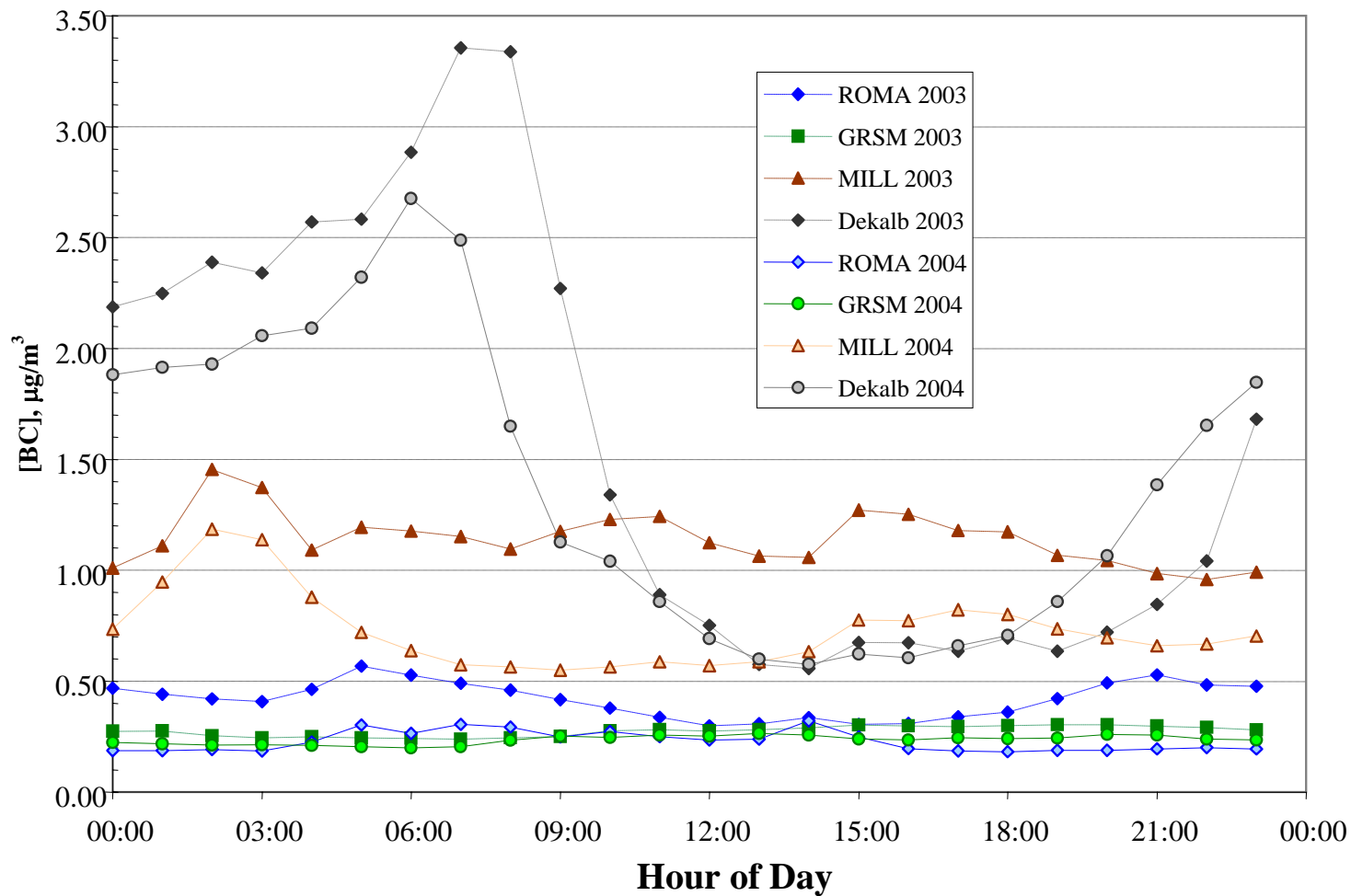


Lessons Learned from Continuous Monitors

- Diurnal and seasonal trends:
 - Black Carbon
 - Similar loadings in all seasons
 - Dekalb > MILL > GRSM = ROMA
 - Peaks correspond to AM and PM rush hours in urban areas
 - Primary emissions, local sources,
 - Total Carbon
 - MILL > GRSM = ROMA
 - At GRSM, TC and OC are slightly higher in summer than other seasons; other sites show no seasonal trend

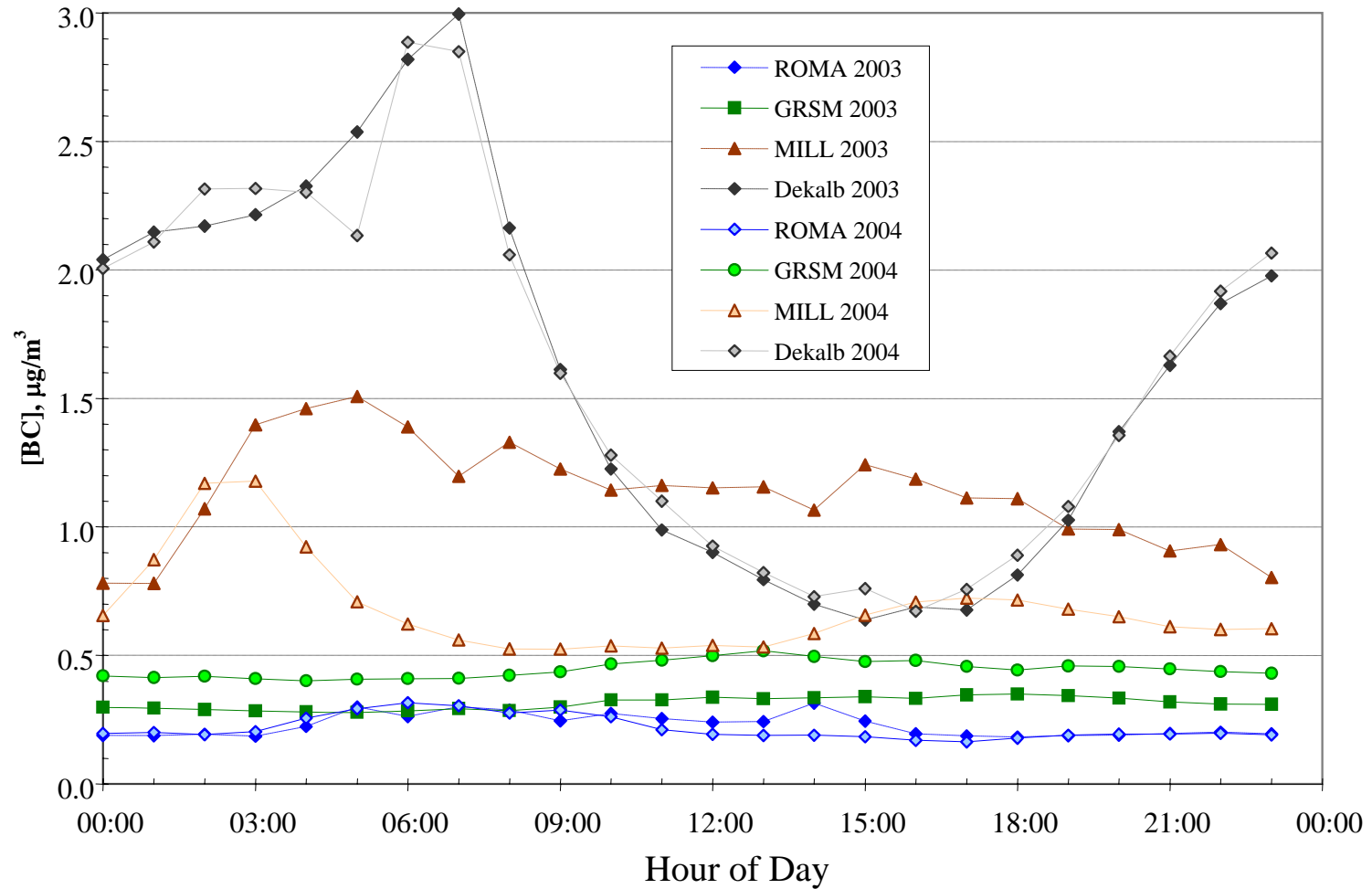


Diurnal Pattern of Average Black Carbon in Spring at Focus Sites



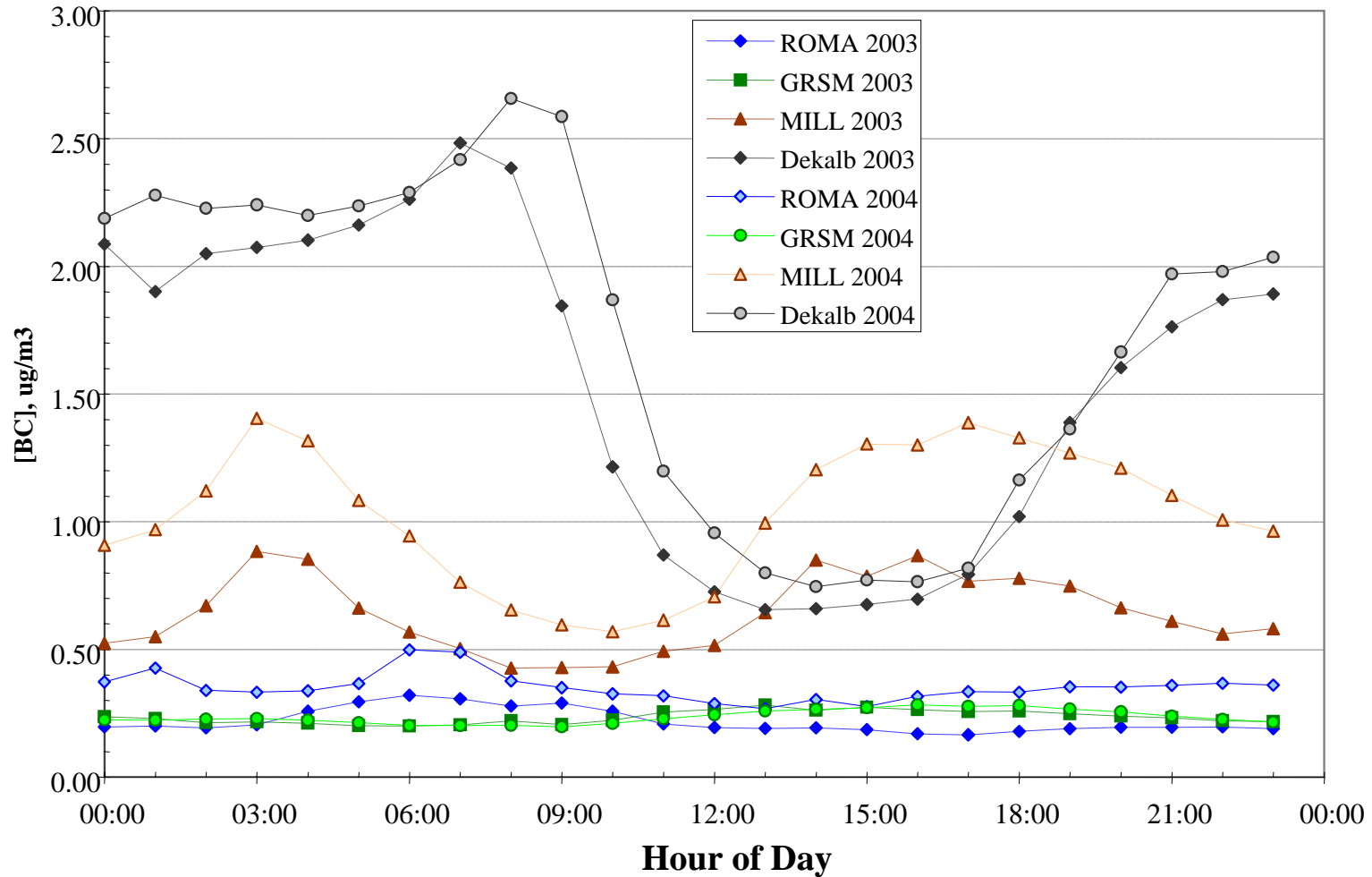


Diurnal Pattern in Average Black Carbon in Summer at Focus Sites





Diurnal Pattern in Average Black Carbon in Fall at Focus Sites





Next Steps

- Finalize draft report for VISTAS Continuous Monitoring
 - Additional analyses?
- Compare diurnal trends from continuous data (2003, 2004) to CMAQ model diurnal trends (2002)
 - Use monthly averages since different years
- Compare trends to SEARCH data
- Submit manuscript for publication