

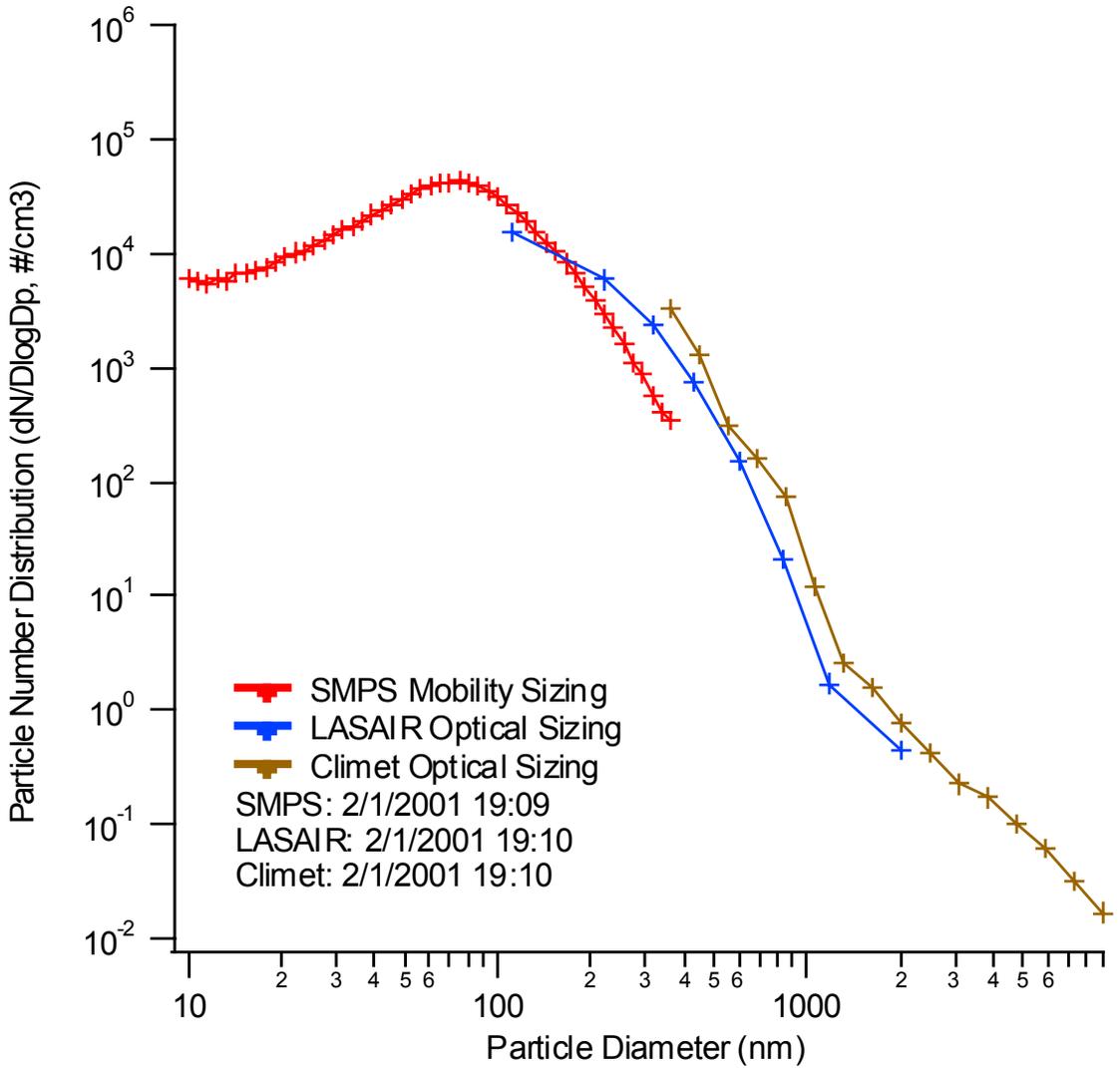
# Particle Size Distributions: Data Analysis

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# Size Distribution Measurement System

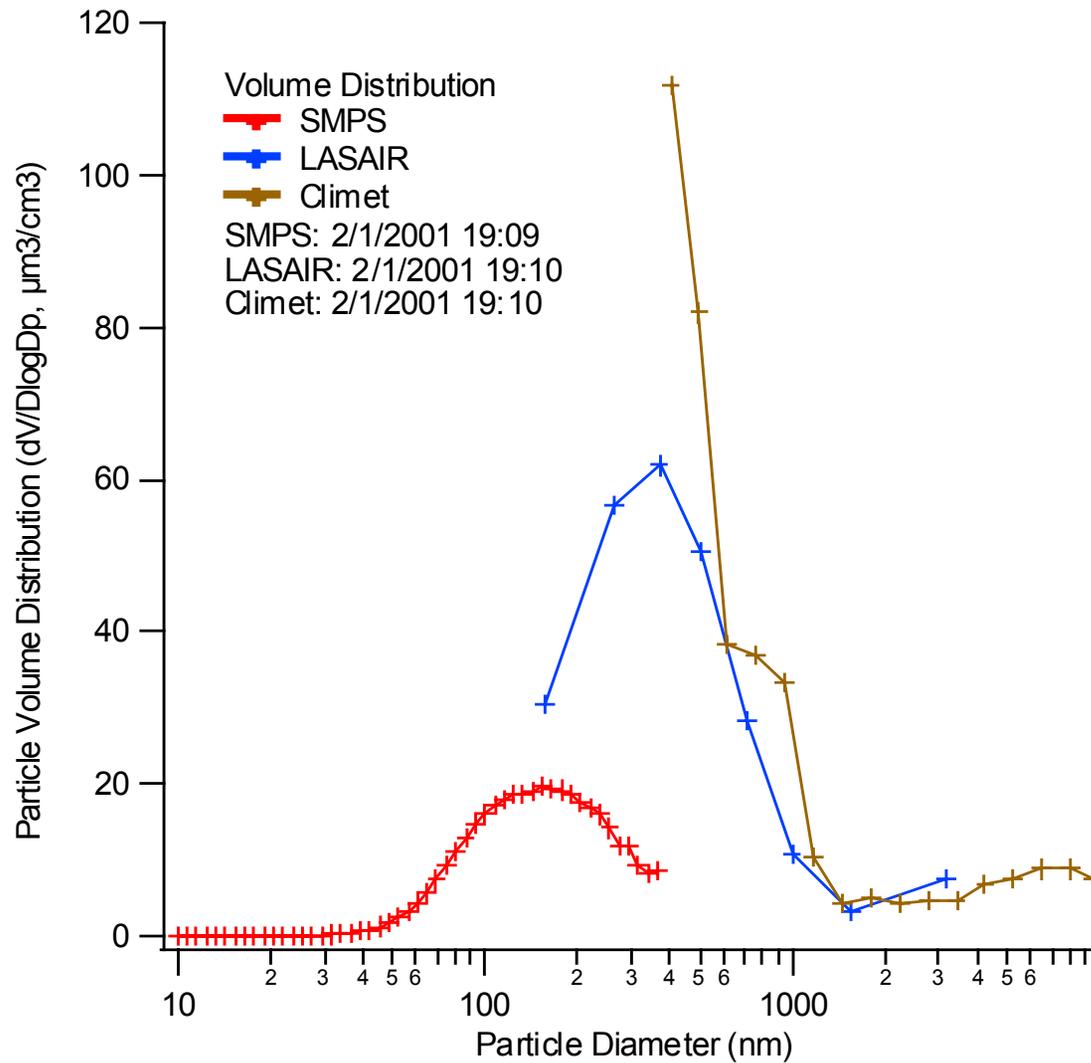
- **SMPS**
  - scanning mobility particle spectrometer
  - particle sizing by electrical mobility,
  - (assume equilibrium charge distribution)
  - size range: 10 nm - 350 nm
- **LASAIR**
  - optical sizing
  - size range: 120 nm to 2000 nm (2  $\mu\text{m}$ )
- **Climet**
  - optical sizing
  - size range: 500 nm to 10000 nm (10  $\mu\text{m}$ )

# Combined Data: Number Distribution

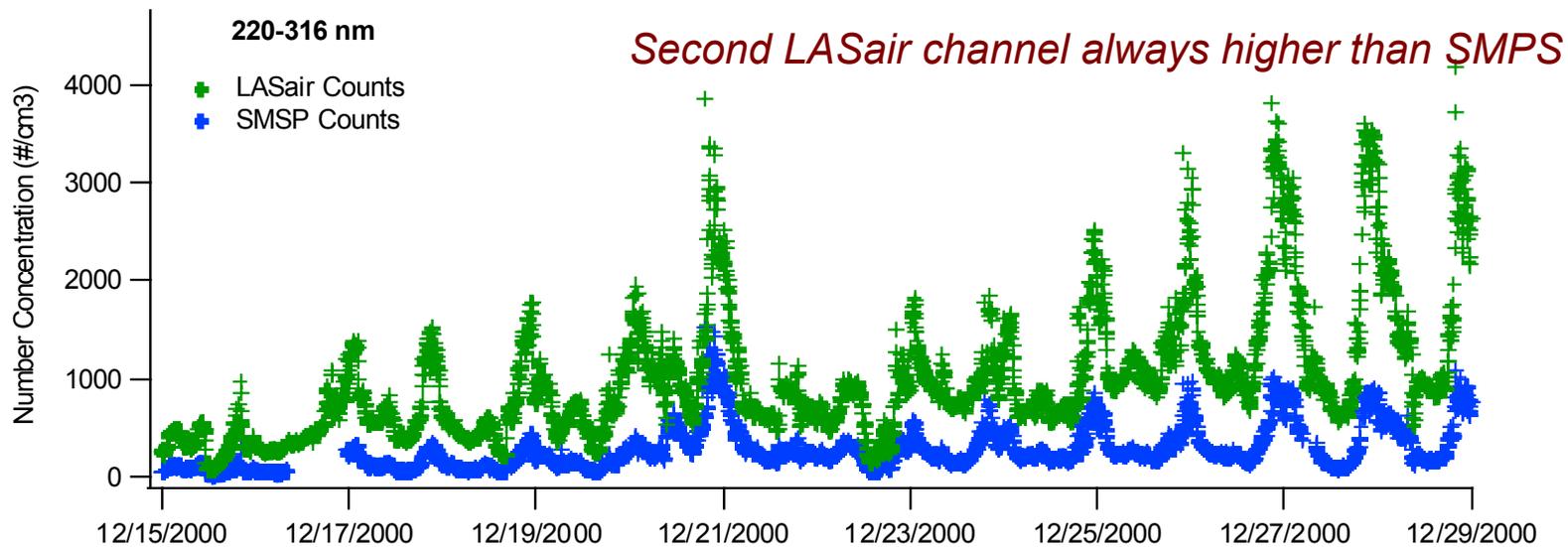
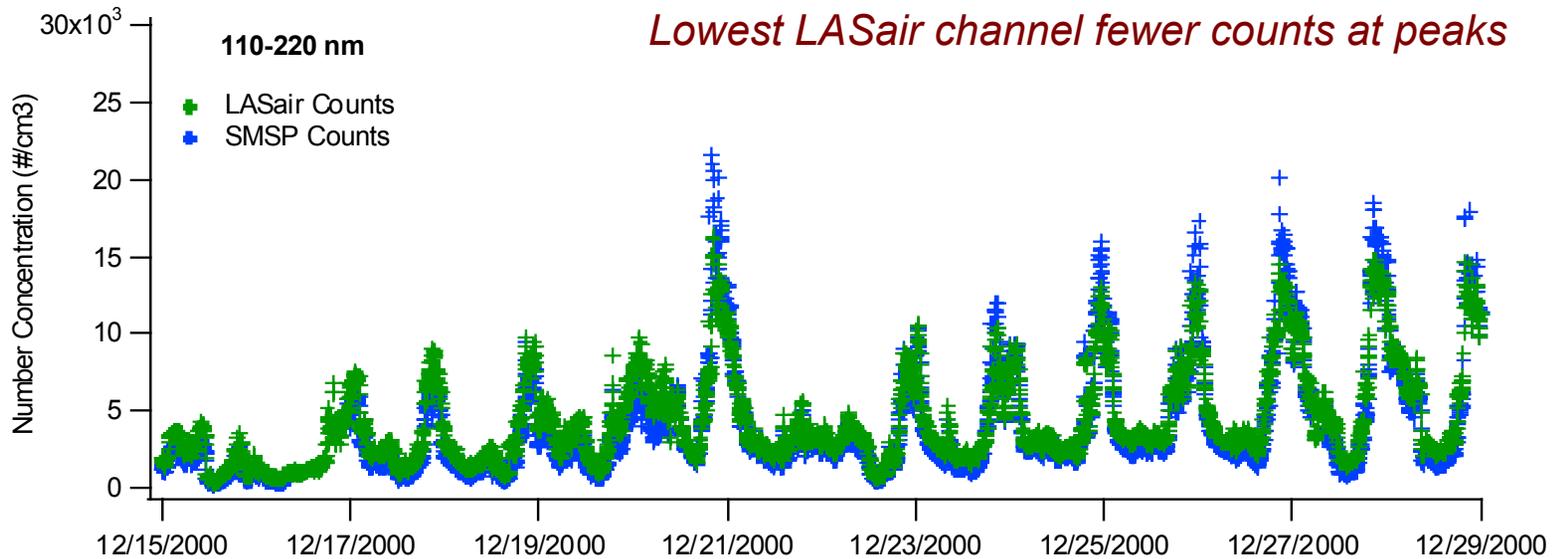


Fresno First Street

# Same Data as Particle Volume Distribution



# Systematic Difference Among Instruments



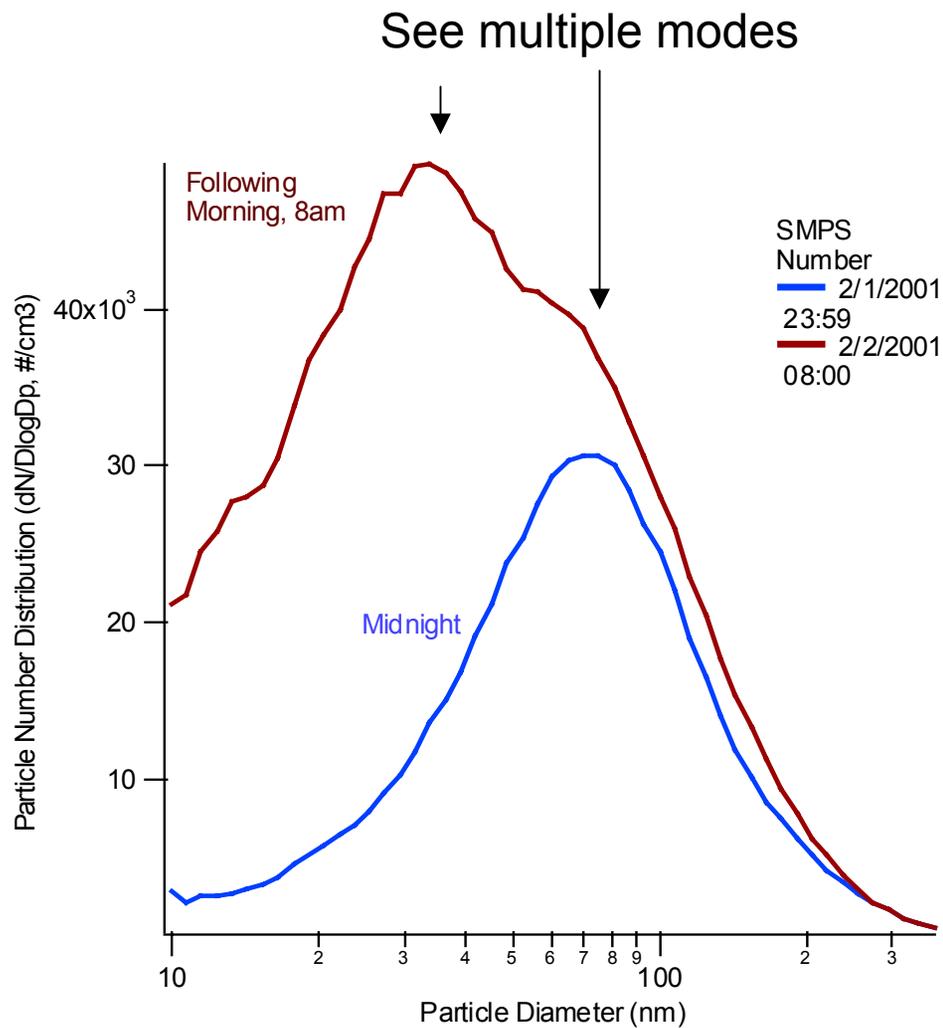
## Why the Differences ?

- SMSP has assumed an equilibrium particle charge distribution, and corrects measured counts for this assumed charge fraction
- Optical and mobility sizing differ, but performed DOS and PSL calibrations on optical instruments. Differences persist with either calibration factors.

## How to Handle these Differences ?

- Treat each sizing method independently.
  - Ultrafine=> SMPS; Accumulation=> LasAir; Coarse => Climet
- Merging into a single distribution will produce inherent “bumps” at transition.

# SMPS Particle Number Distribution



# SMPS Distributions: Bimodal, Lognormal Deconvolution

Each size distribution is expressed as a sum of two lognormal distributions:

$$dN = dN_a + dN_b$$

$$dN_a = \frac{N_a}{\sqrt{2\pi} \ln \sigma_{g,a}} \exp \left[ -\frac{\ln(D_p / D_{pm,a})^2}{2(\ln \sigma_{g,a})^2} \right] d \log(D_p)$$

Size Distribution Movie  
Fresno First Street  
Feb 1 – 3, 2001

Look for:

- How well the bimodal deconvolution generally captures the major characteristics of the distribution.
- Differences in character from nighttime and day time distributions.

# Can we use the Bimodal, LogNormal Parameters to Quantify these Observations?

For each mode:

$N$  = number of particles

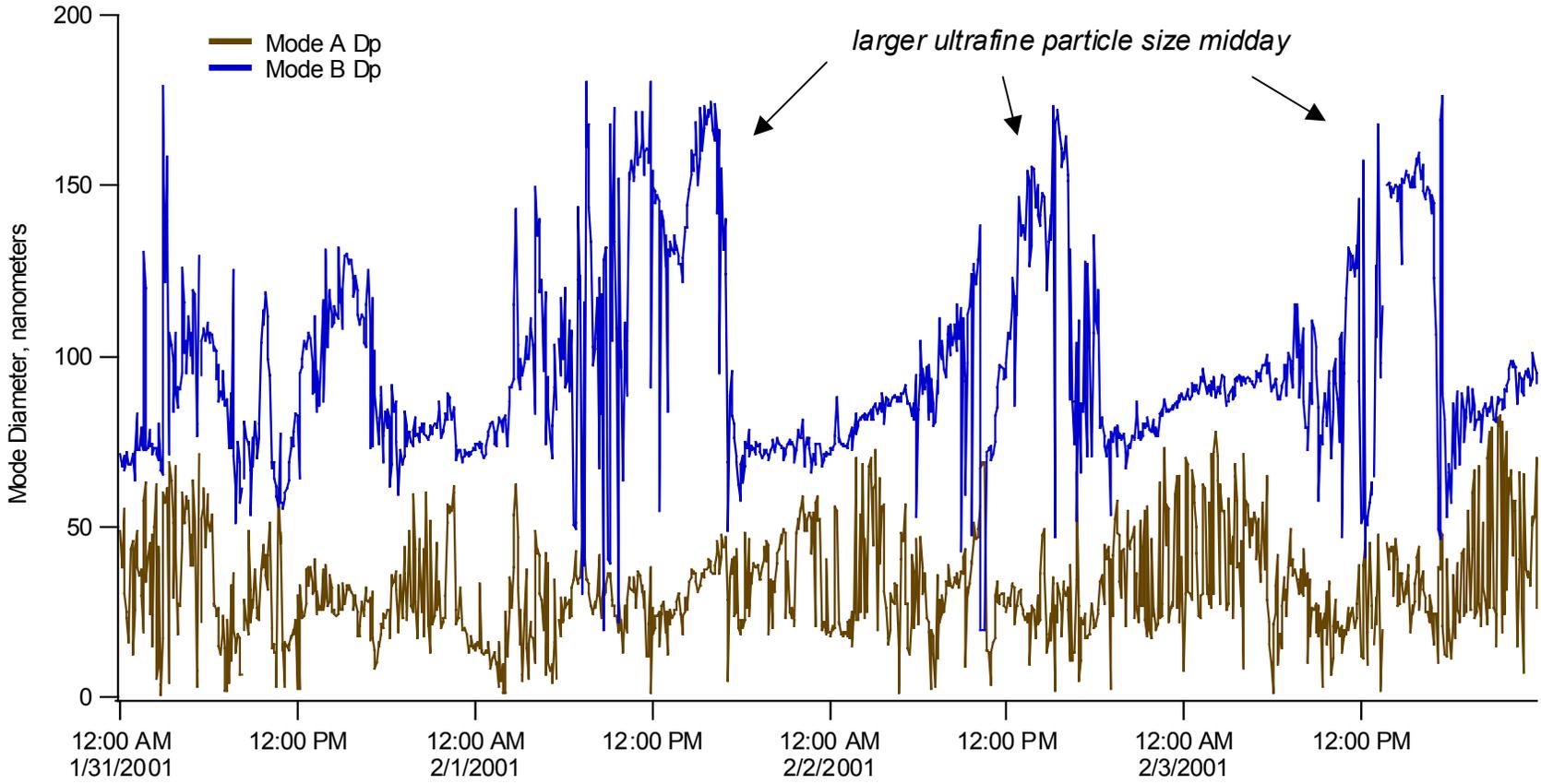
$D_{gm}$  = geometric mean diameter

$\sigma_g$  = geometric standard deviation

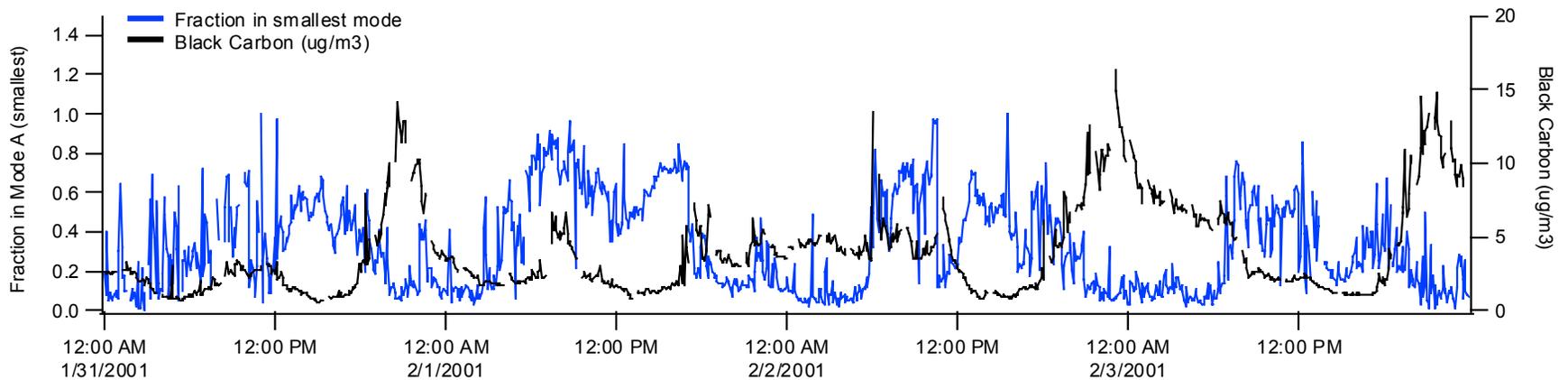
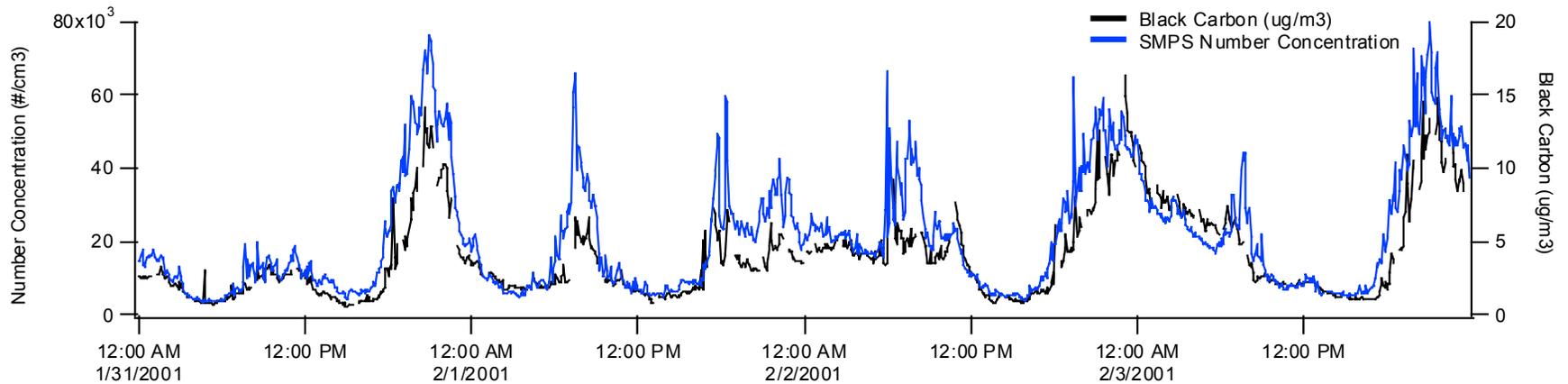
With two modes => 6 parameters.

How well do these parameters to characterize the temporal and spatial variability of the size distributions?

# Mode Diameters: Jan 31-Feb 3, 2001 Data



# Comparison with Black Carbon



- *Ultrafine number tracks black carbon*
- *Lower fraction of particle number in smallest mode*

## Summary: Size Distribution Analysis

- Discrepancies among instruments makes it difficult to synthesize data into a uniform distribution.
- Modal analysis from one instrument (SMPS) provides means to
  - Investigate temporal variations
  - Comparison with chemical constituents
- Ultrafine distributions more stable at night
  - Small mode (A) appears in early morning
  - Larger mode (B) has larger diameter midday
- Black carbon and SMSP number track, while the fraction associated with the small mode (A) varies inversely with BC level.

# TEMPORAL AND SPATIAL DISTRIBUTION OF PARTICULATE NITRATE AND LIGHT SCATTERING

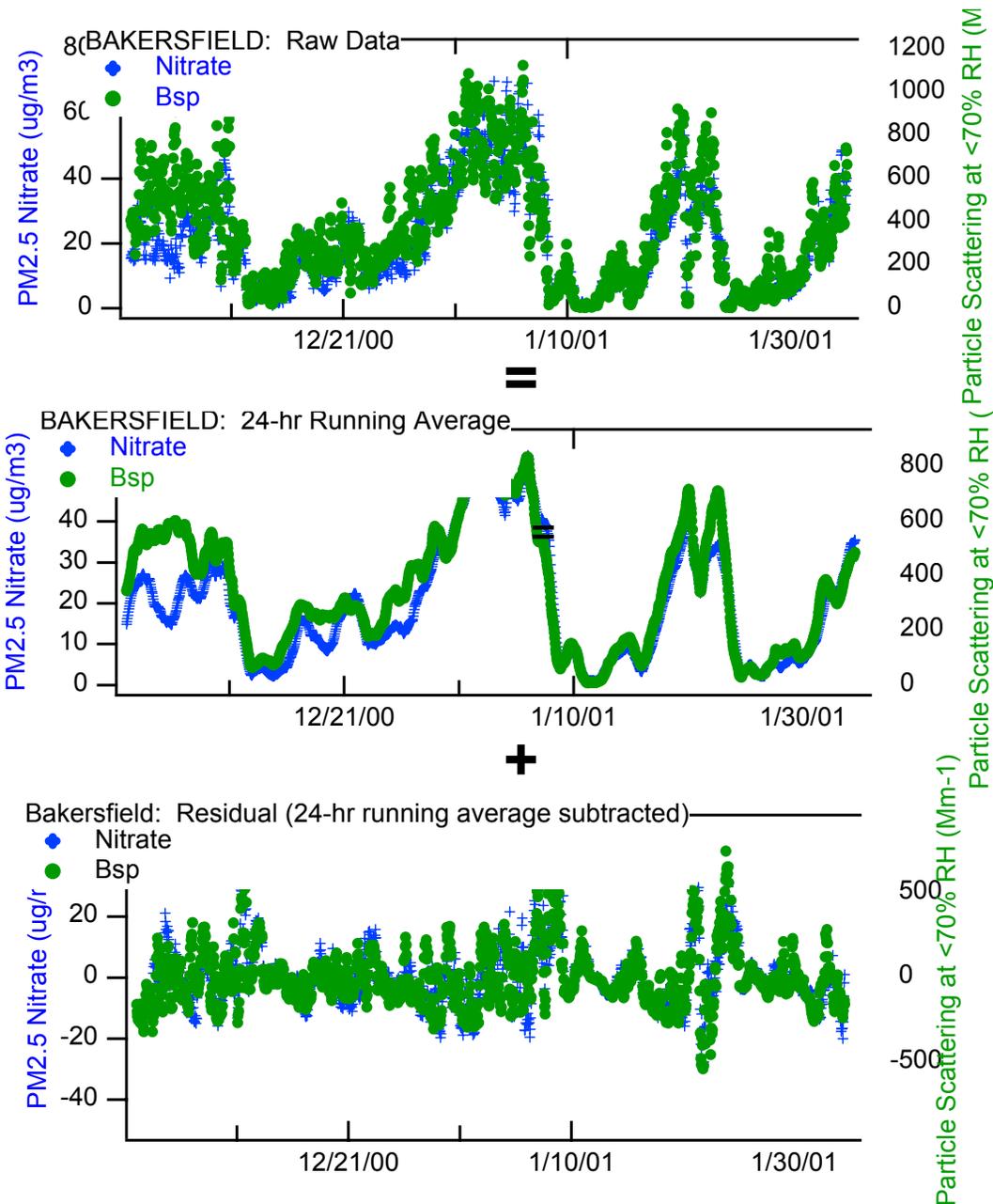
Susanne Hering, Nathan Kreisberg,  
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Judith Chow, John Watson,  
*Desert Research Institute*,  
L. Willard Richards,  
*Sonoma Technology Inc.*

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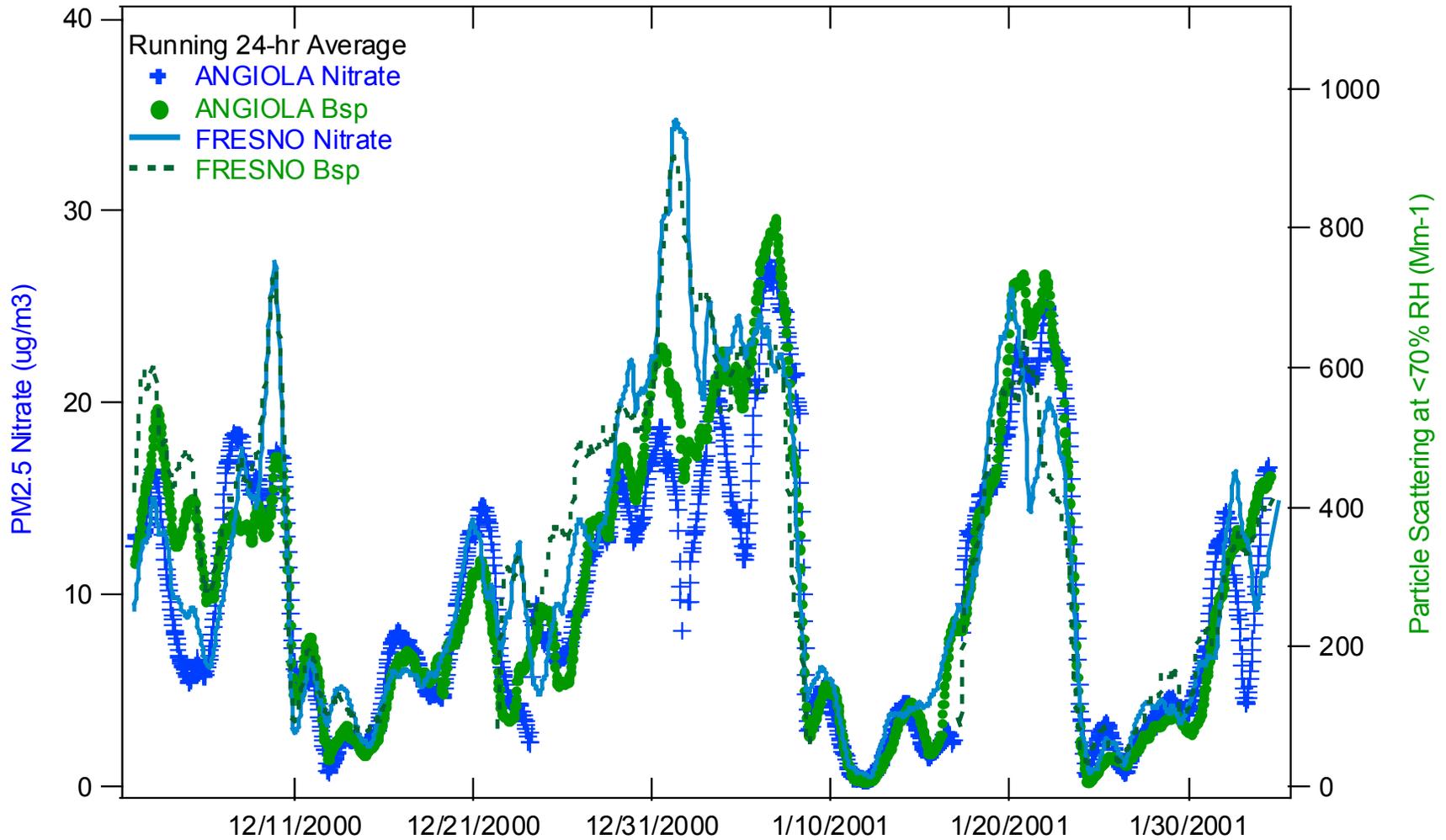
Sites and Constituents  
compared using 10-min data  
base

Multiday trends separated from  
daily pattern.

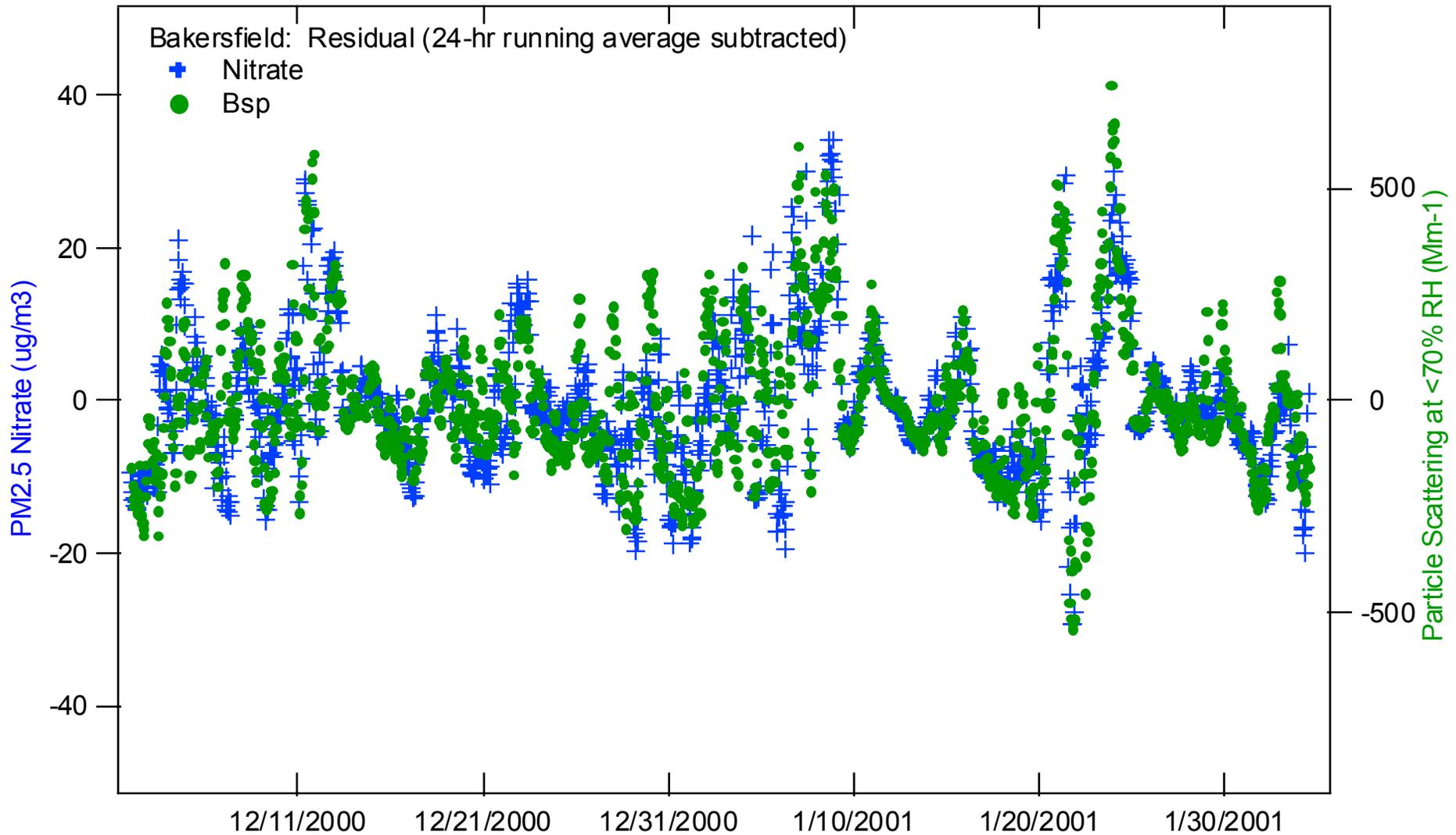
Each frequency domain  
compared separately.



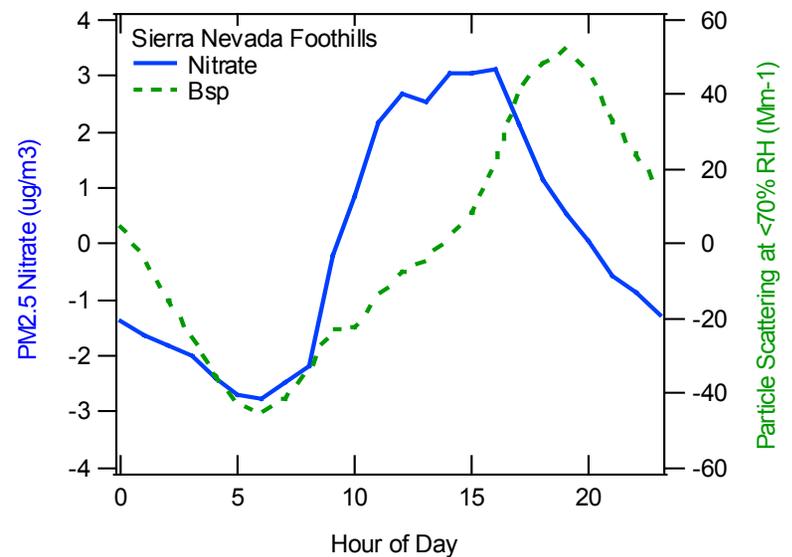
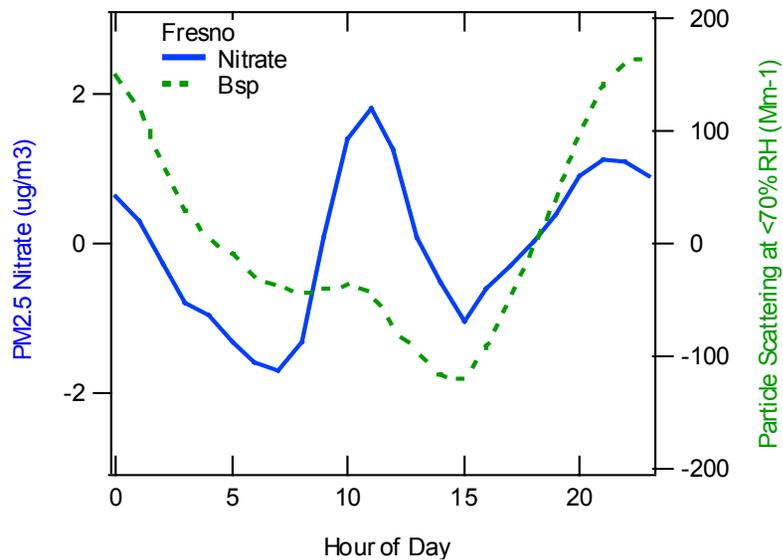
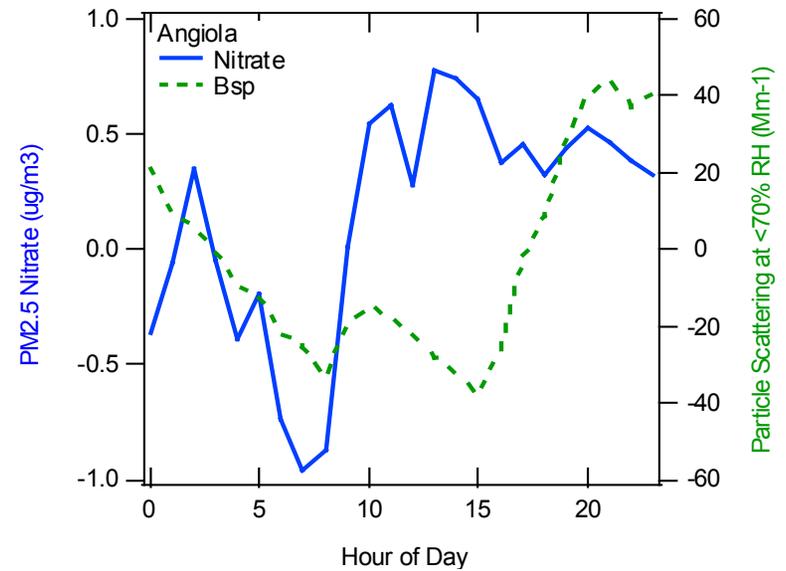
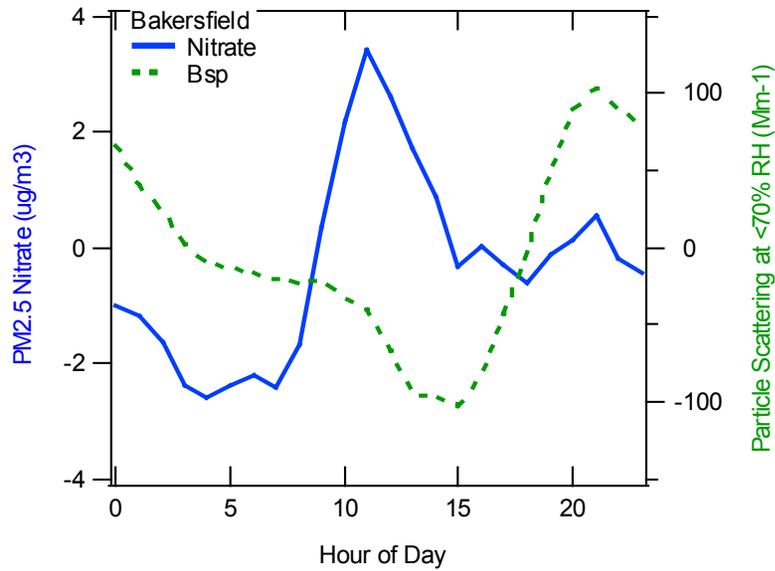
# Comparison among sites for 24-hr average



# Residual, after subtracting running 24-hr average



# Comparison among Constituents in 24-hr Pattern



# Bsp and Nitrate Analysis

- Subtract out overall multi-day pattern to discern the daily pattern, and how this varies among constituents and sites
- Nitrate maxima occurs earlier in the day at Bakersfield and Fresno than at Angiola or Sierra Nevada Foothills.
- Note there is also a seasonal pattern -- not shown here.