

CRPAQS Visibility Findings

Conceptual Model Development
Meeting

December 5, 2005



Visibility Questions

- What light extinction efficiencies are appropriate for the CRPAQS domain?
- What are the spatial and temporal characteristics of visibility?
- How do different chemical constituents contribute to visibility reduction?
- What are the sources of summertime light extinction in the Mojave Desert?
- Sources: ENSR, STI, DRI



Light Extinction Efficiencies

- The light extinction coefficient is the fractional reduction in light intensity per unit path length of atmosphere (b_{ext}).
- B_{ext} = light extinction efficiency x concentration of individual chemical components
- IMPROVE program has standard light scattering efficiencies for each chemical component (sulfate, nitrate, OC, EC, fine soil)
- These scattering efficiencies were reviewed based on CRPAQS data



Comparison of Light Extinction Coefficients

Light Extinction Efficiency (m²/g)^a

Constituent	CRPAQS	IMPROVE	IMS95
Ammonium Nitrate	3[2.94f(RH)-2.57]	3f(RH)	2.1/(1-RH/100) ^{0.7}
Ammonium Sulfate	3[2.94f(RH)-2.57]	3f(RH)	2.1/(1-RH/100) ^{0.7}
Organic Compounds	4	4	2.8/(1-RH/100) ^{0.2}
Elemental Carbon	10	10	10
Fine Soil	1	1	2

^a RH = relative humidity (percent)



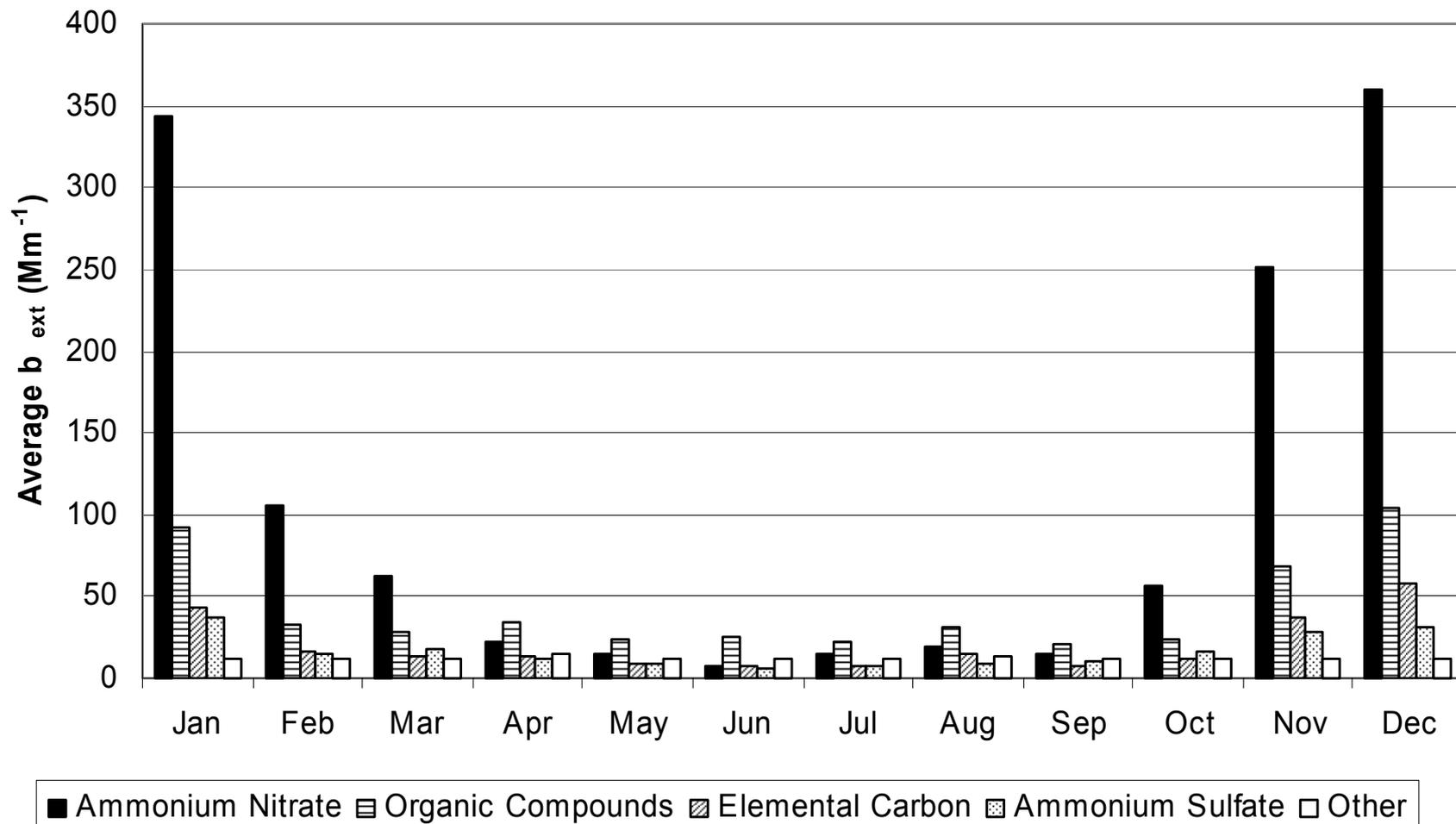
Spatial and Temporal Variability of Light Extinction

- Winter average light extinction values were approximately 2 to 6 times higher than summer average values
- Winter daily average light extinction varied twenty-one fold between sites:
 - 20 Mm^{-1} at Olancho, Edwards, China Lake
 - 300 Mm^{-1} at Bakersfield, Edison, Visalia



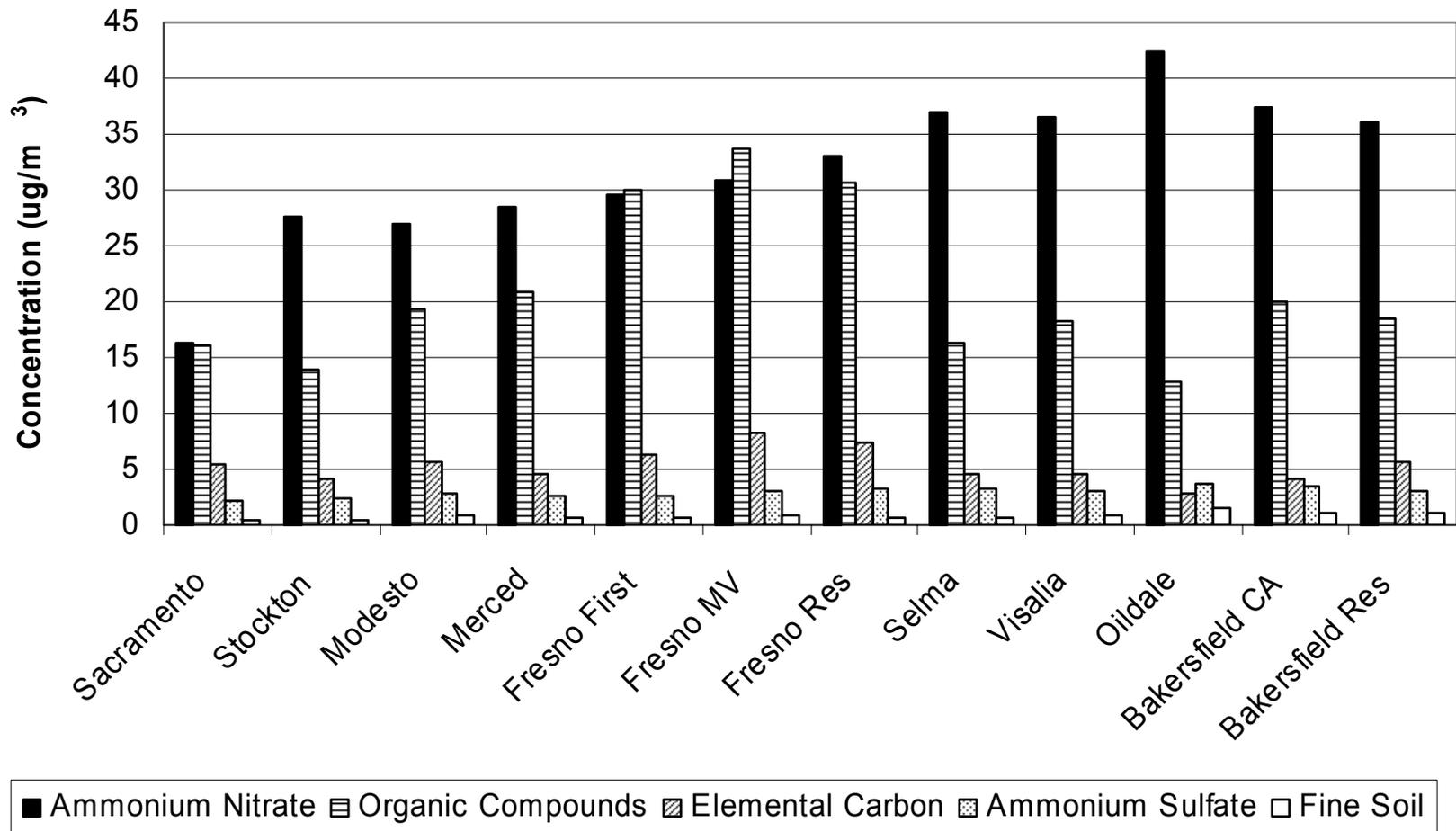
Temporal Variability in Chemical Composition Contributions to Visibility

Fresno First Street



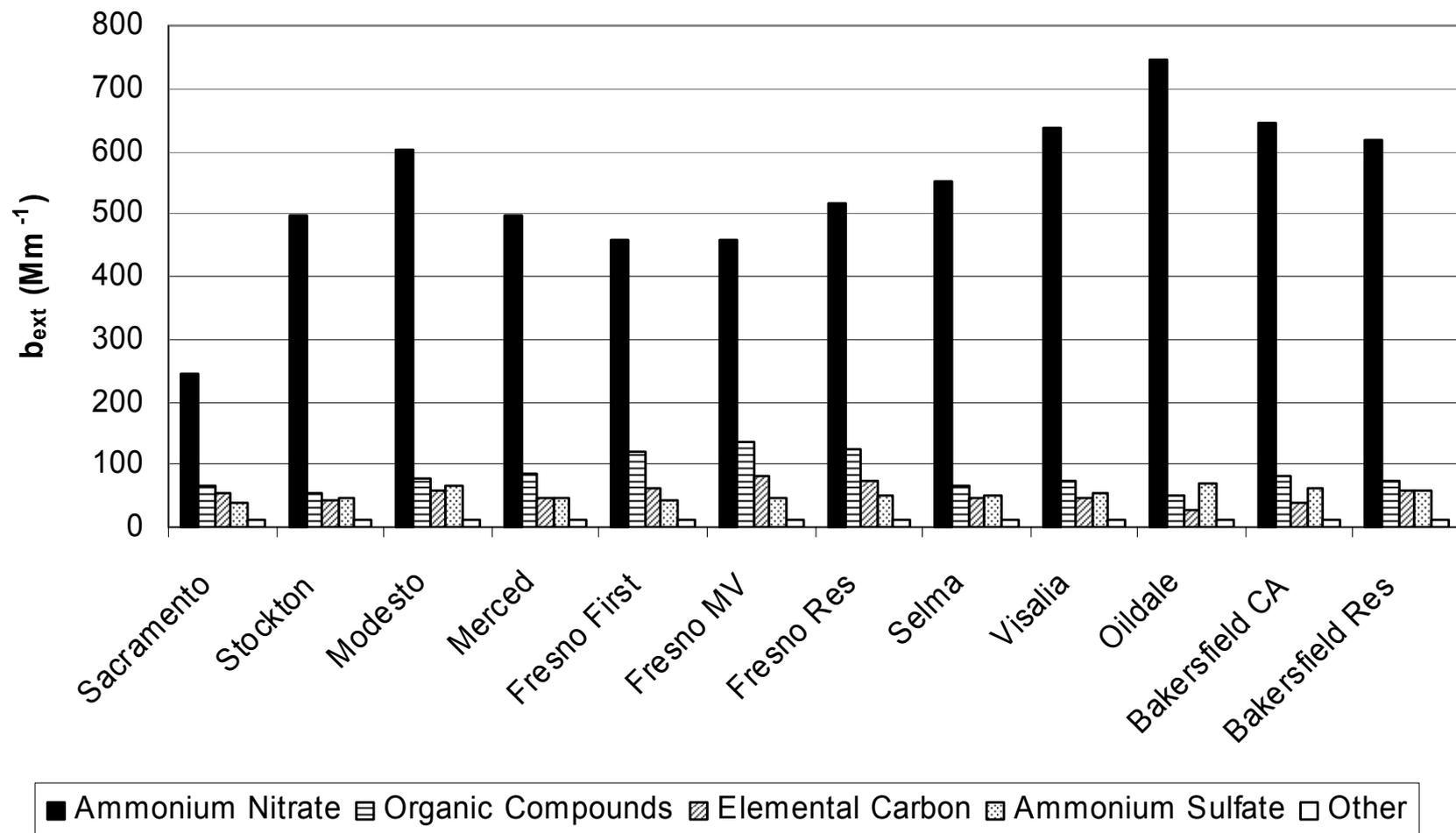
Spatial Variability of Chemical Composition on Worst Days

Constituent Concentrations, 20% Highest b_{ext} Days



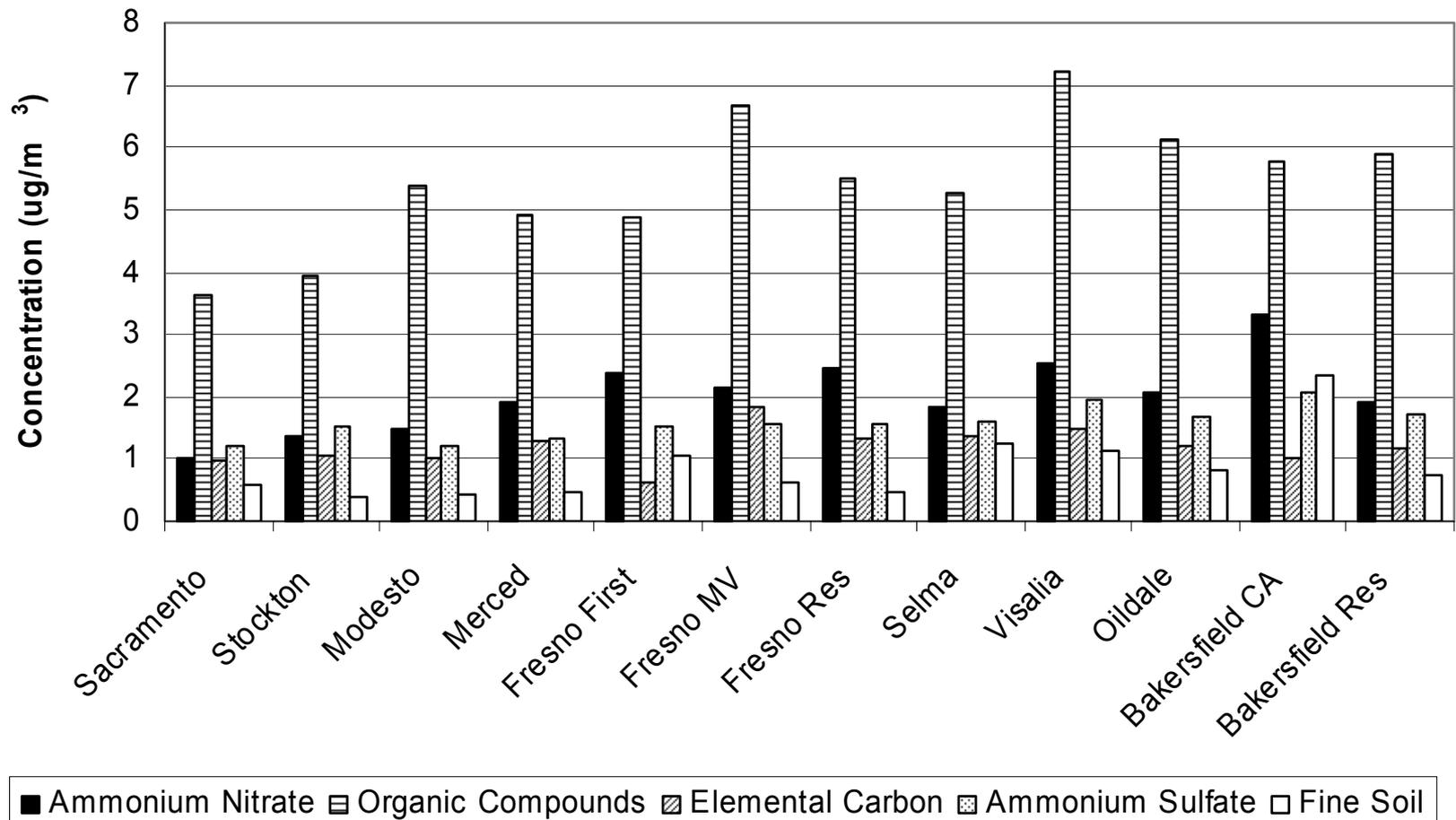
Spatial Variability of Chemical Contribution to Visibility on Worst Days

Constituent Contributions to b_{ext} , 20% Highest Days



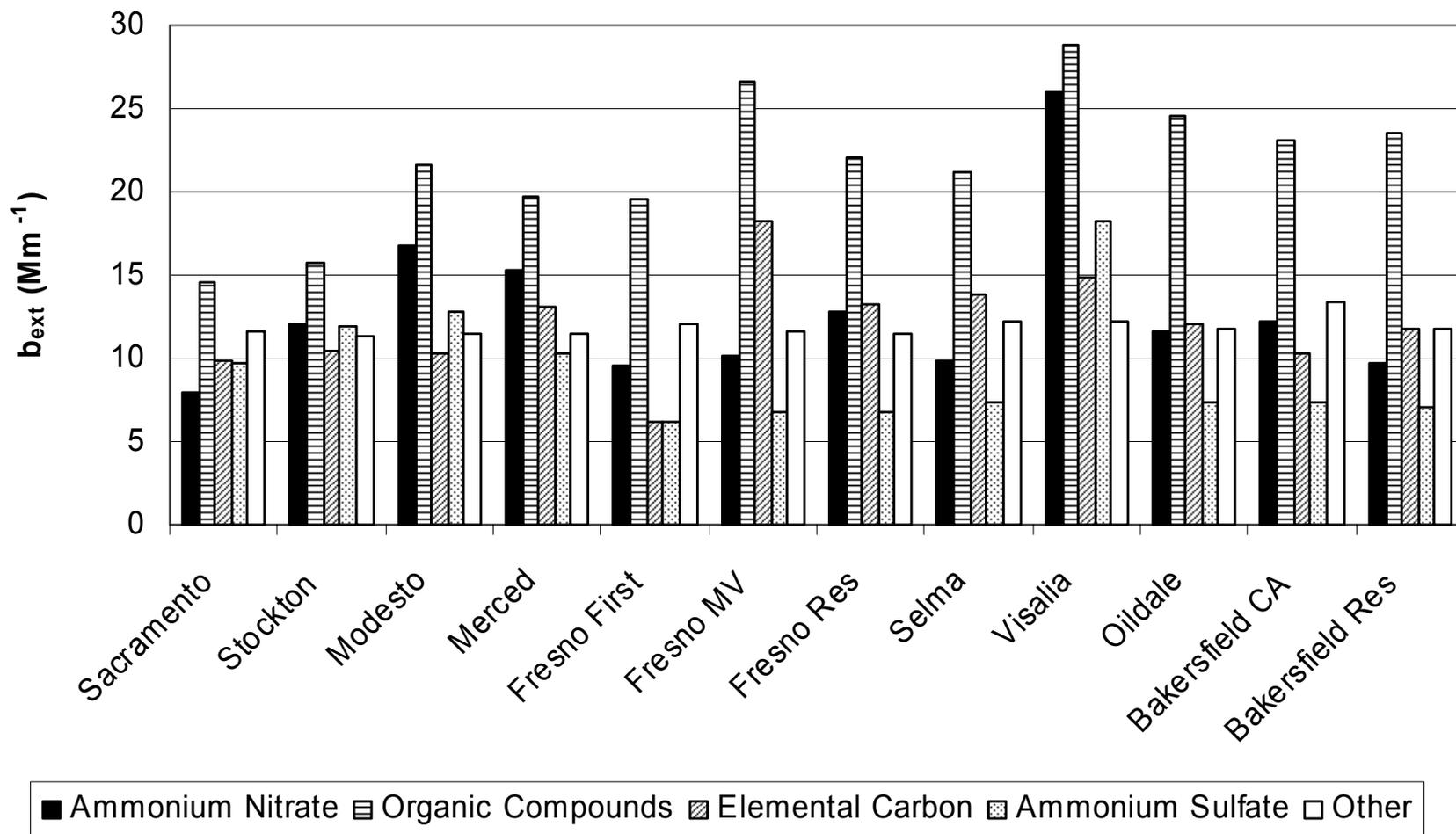
Spatial Variability of Chemical Composition on Best Days

Constituent Concentrations, 20% Lowest b_{ext} Days



Spatial Variability of Chemical Contribution to Visibility on Best Days

Constituent Contributions to b_{ext} , 20% Lowest Days

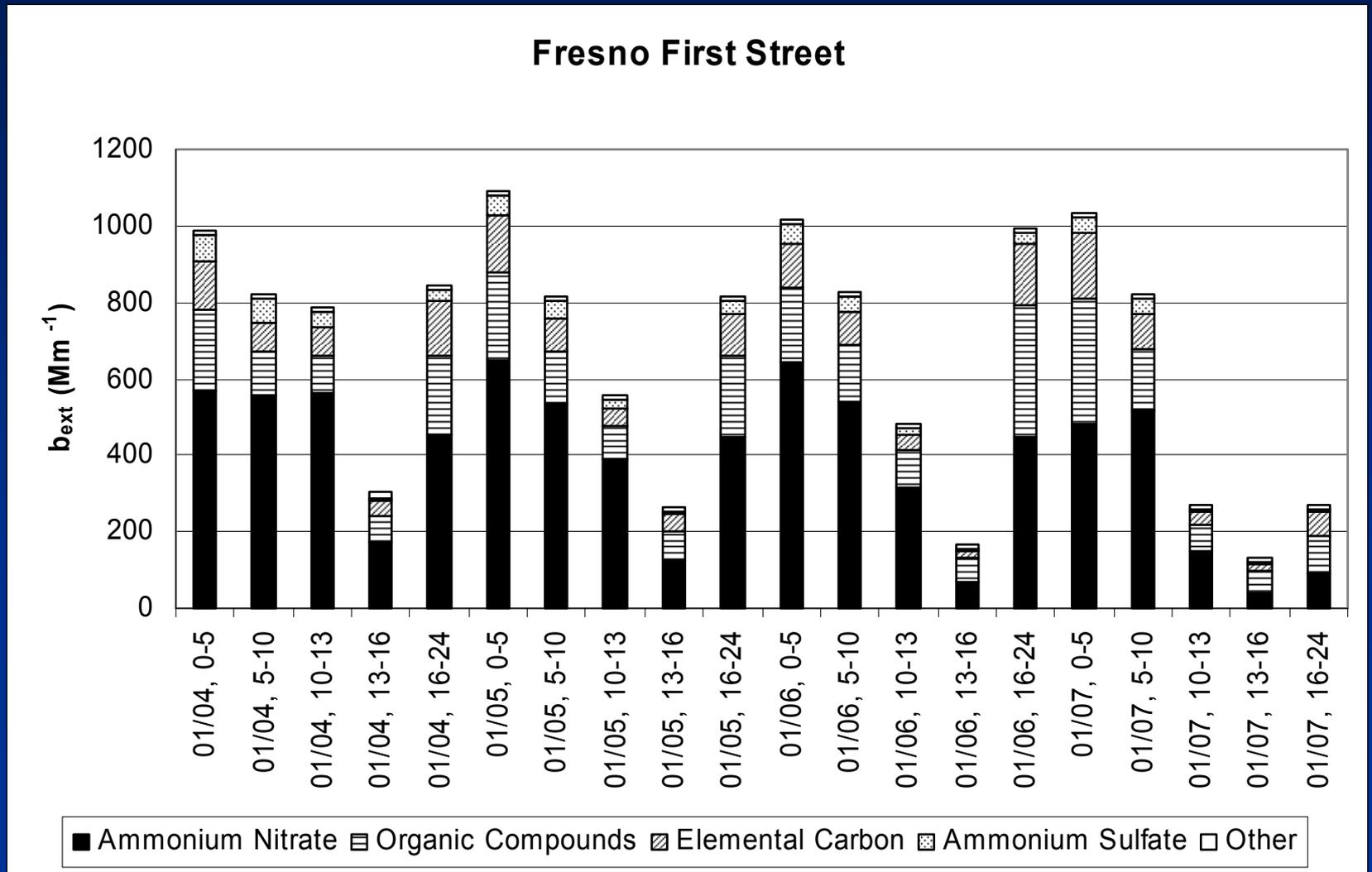


Comparison of Calculated b_{ext} on Days with PM_{2.5} Mass Above and Below the 24-Hour NAAQS

Site	Total Days	PM _{2.5} > NAAQS ^b		PM _{2.5} ≤ NAAQS ^b	
		Days	Average b_{ext} (Mm ⁻¹)	Days	Average b_{ext} (Mm ⁻¹)
Sacramento	14	3	766	11	312
Fresno Residential	13	11	778	2	610



Diurnal Variability of Chemical Contribution to Visibility



Visibility in the Mojave Desert

- Contributions to light extinction in the Mojave Desert were not calculated due to lack of sufficient data
- Nine periods of reduced visibility were analyzed to assess the meteorological conditions associated with each event:
 - Three episodes were found to be local or isolated events.
 - Five episodes occurred under synoptic trough passages with strong winds
 - One episode occurred under summer monsoonal conditions.
- Non-local events showed transport from the SJV and in several cases the South Coast as well

