9th Conference on Air Quality Modeling – A&WMA AB-3 Comments on Modeling $PM_{2.5}$ Emissions

presented by
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Air Pollution Meteorology (AB-3) Committee

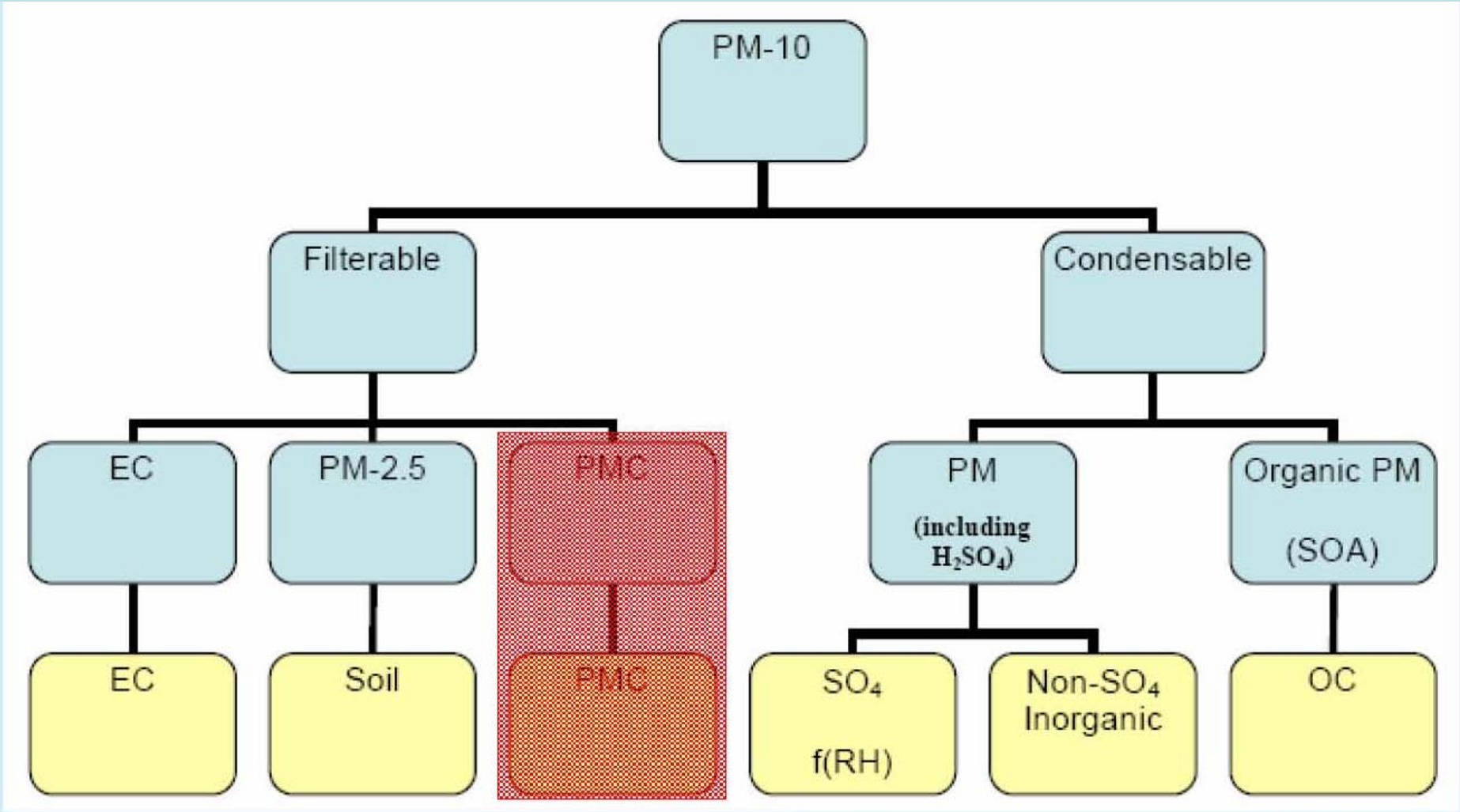
Comment Areas

- Characteristics of $PM_{2.5}$ – newest and possibly least understood criteria pollutant
- Quantifying $PM_{2.5}$ emissions
- Current and proposed regulatory requirements
- Challenges to $PM_{2.5}$ implementation
  - Emissions inventories – direct and precursors
  - Modeling techniques – guidance?
  - Background concentrations – how to treat
- Looking forward

Characteristics of $PM_{2.5}$ - A Significant Modeling Challenge

- Unlike other gaseous criteria pollutants, because $PM_{2.5}$…
  - Generally comprises a mixture of solid particles and liquid droplets, some condensing from vapor – source/fuel-specific
  - Is emitted directly from a source ("primary" or "direct" emissions) and also formed in the atmosphere ("secondary formation") from precursor emissions of SO_2 and NO_x
  - Contains filterable and condensable components that may be organic or inorganic

Characteristics of $PM_{2.5}$



Source: VISTAS BART Modeling Protocol (2006)

$PM_{2.5}$ Emissions Measurement Techniques

- Only filterable PM has traditionally been measured, quantified, and modeled based on EPA Reference Method 5
- Existing reference methods for condensable PM have known biases and work is underway to propose more reliable methods
- EPA is well aware of limitations to existing $PM_{2.5}$ measurement methods – sulfates can be significantly overestimated
- Uncertain emission factors exist for condensable PM – this can be a high percentage of $PM_{2.5}$

$PM_{2.5}$ Regulations and Guidance

- PM_{10} surrogate policy for compliance modeling still in effect
- Best Available Retrofit Technology implementation guidance
- $PM_{2.5}$ NSR implementation rule
- $PM_{2.5}$ PSD SILs, SMCs, and increments (proposed 9/21/07; final rule pending)
- PSD increment modeling procedures (proposed 6/6/07; final rule pending)

Modeling Primary vs. Secondary $PM_{2.5}$

- AERMOD considers primary $PM_{2.5}$ only
- Primary $PM_{2.5}$ provides highest near-field impacts
- Secondary $PM_{2.5}$ only at large distances
- Would probably not contribute at location of highest primary impact
- Secondary $PM_{2.5}$ could be modeled with CALPUFF
- Large SO_2 and NO_x emission reductions may lead to $PM_{2.5}$ increment expansion – does this require an unbiased model to take modeling credit?
- Are we ready to compile cumulative emission inventories for 3 pollutants?

$PM_{2.5}$ Regulations and Guidance – Unresolved Issues

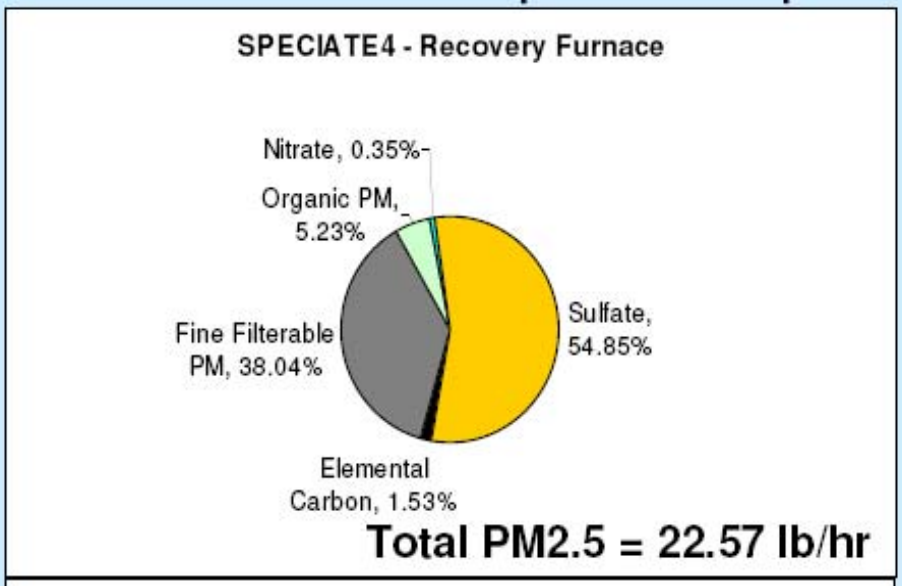
- Ignore secondary $PM_{2.5}$ modeling for short-range applications
- Include secondary $PM_{2.5}$ modeling for long-range applications (e.g., Class I increment)?
- How to credit precursor emission reductions?
- What is the form of the 24-hour $PM_{2.5}$ increment standard?
  - To be consistent with the NAAQS, the 24-hour increment should be the highest, 8th – highest
  - CALPUFF and AERMOD can provide that statistic

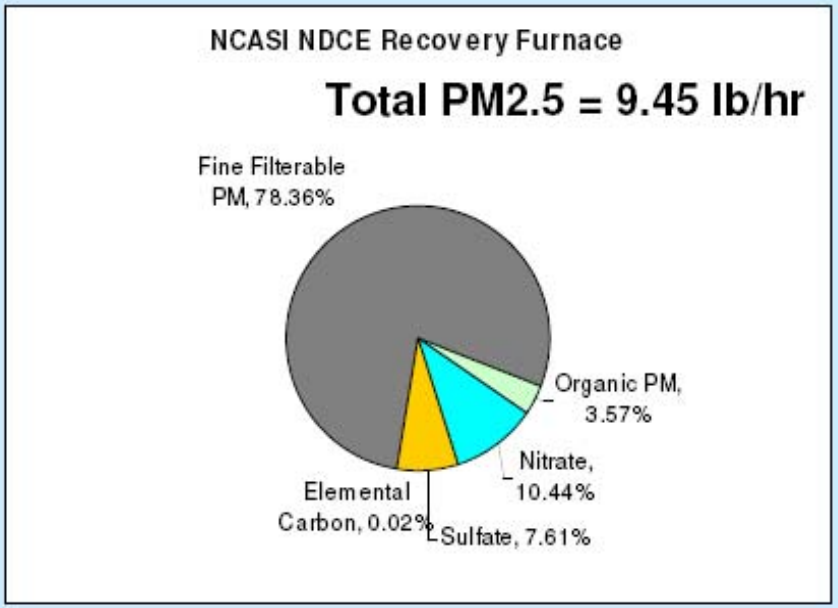
$PM_{2.5}$ Emissions Analysis

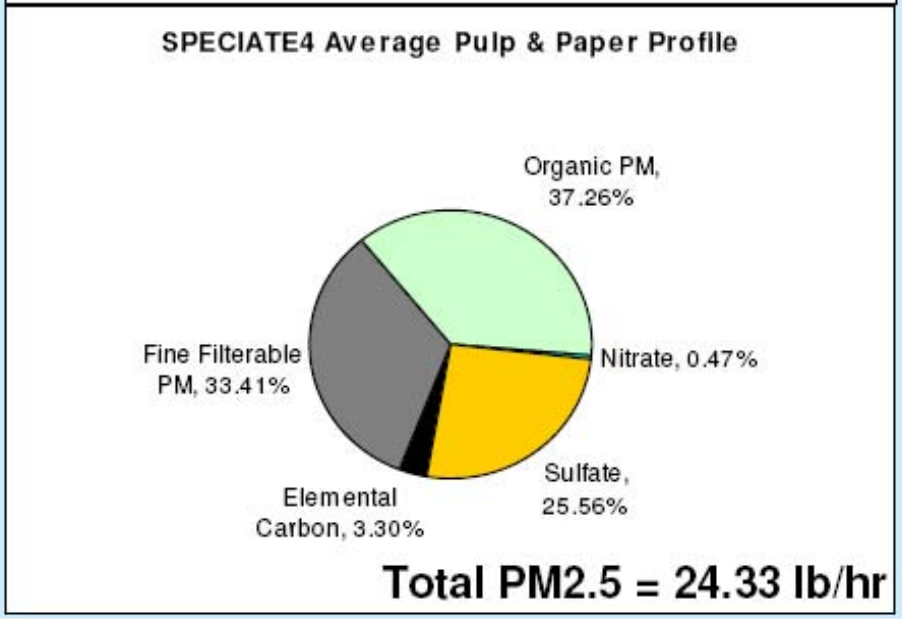
- Emissions factors are available for certain source types from EPA's AP-42, SPECIATE, and FIRE databases
- Certain industry groups have also reviewed stack test data to develop emission factors
- EPA demonstrates possible approach in its *Interim Regulatory Impact Analysis (RIA) for the Proposed National Ambient Air Quality Standards for Particulate Matter, Appendix B – Local Scale Analysis (2005)*
- Any of these factors are based on stack test methods known to be unreliable and have biases

PM2.5 Emissions Case Study

Pulp and Paper Recovery Furnace







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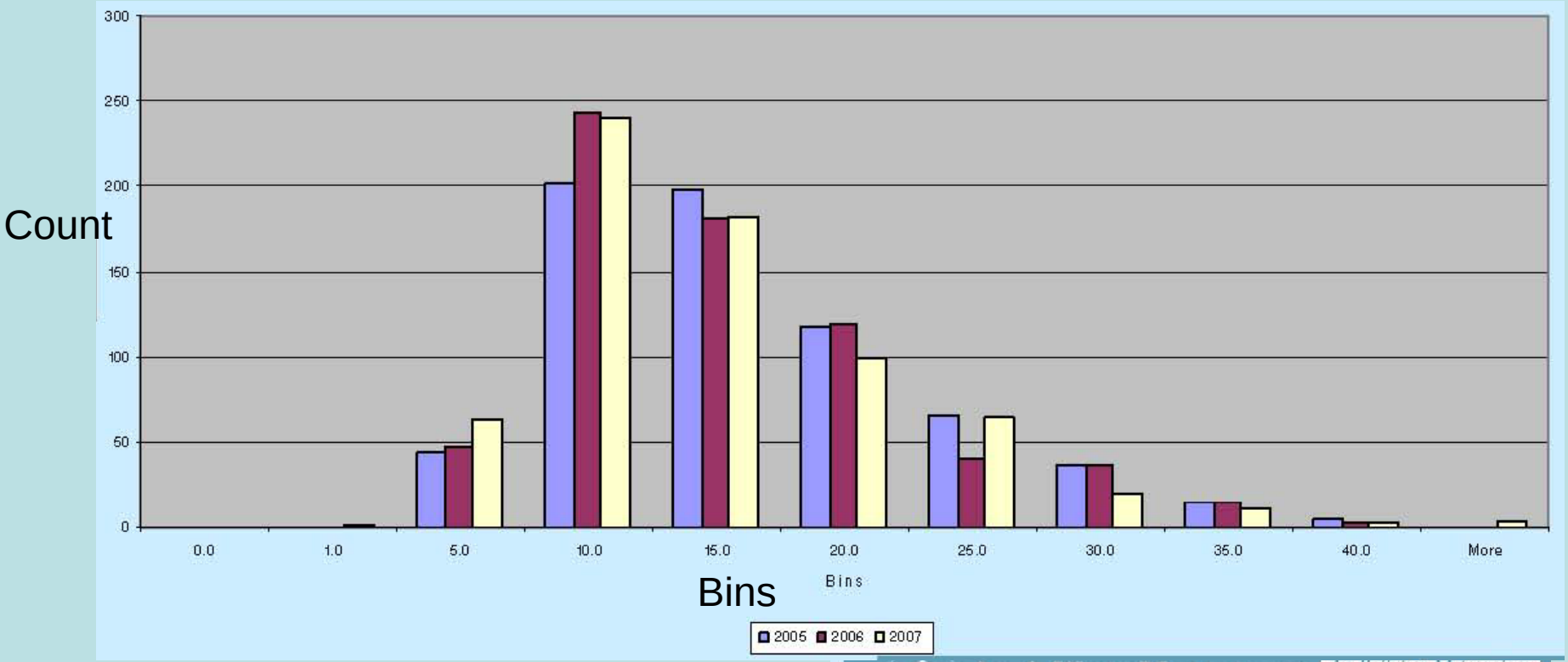
Example Modeling Challenge: Compute Total $PM_{2.5}$ NAAQS Impact: Background + Source Impact

- Conservative approach: add peak percentile source impact to peak percentile background, unpaired in time
- Unlikely that these two components happen at the same time
- Refined approach adds concurrent daily background and source impact concentrations
- If daily background concentrations not available, fill in missing days from higher of two bounding values

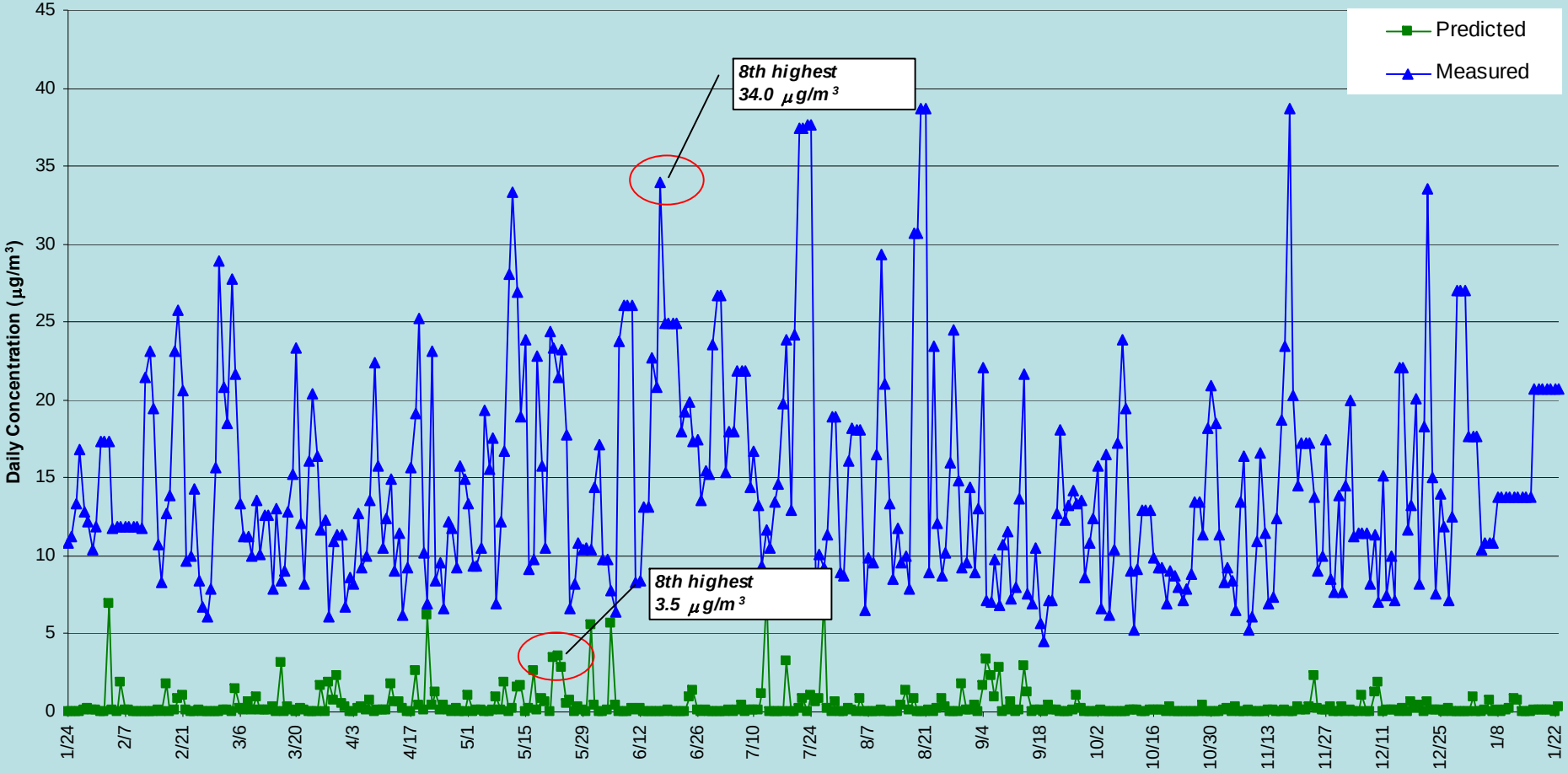
$PM_{2.5}$ Background Concentrations

- $PM_{2.5}$ ambient monitoring data typically shows that most values are well below the NAAQS standard



$PM_{2.5}$ Time Series for Background (Blue) and Source Impact (Green)

8th highest value from unpaired addition = 37.5 µg/m³



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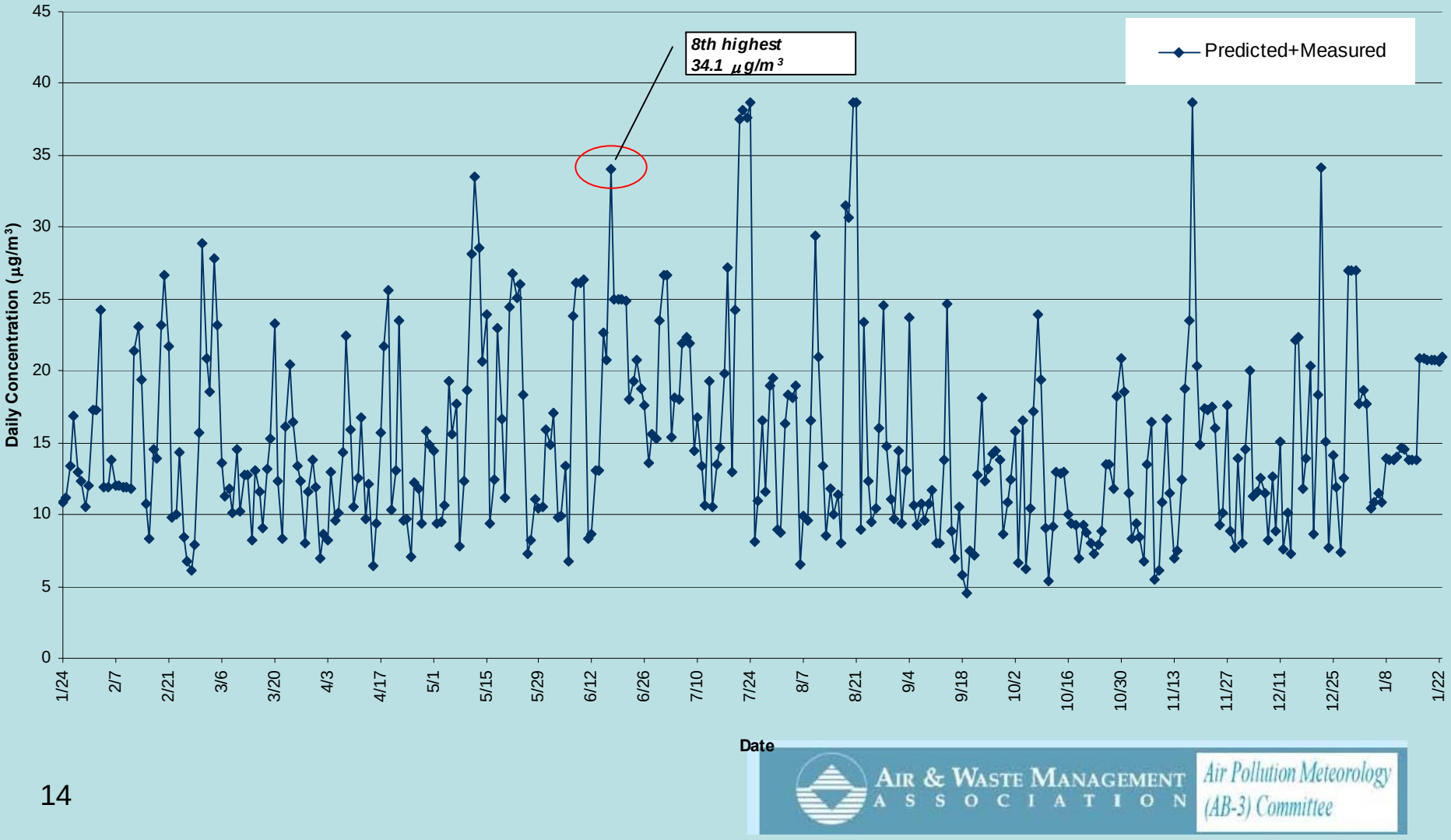
$PM_{2.5}$ Time Series of Concurrent Sum: Background and Source Impact

8th highest value from paired addition = 34.1 µg/m3



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Summary

- $PM_{2.5}$ modeling in a regulatory context poses challenges not previously experienced for other criteria pollutants
- Emissions measurement and modeling techniques need to be resolved
- Background concentrations can be much higher than modeled concentrations
- Due to stringent standards, there is more need for refined modeling approaches
- Collaboration necessary to implement reasonable $PM_{2.5}$ impact assessment requirements

Looking Ahead

- Unique and important issues remain unresolved for $PM_{2.5}$ – little EPA guidance
  - PSD increments and modeling procedures
  - Role of CALPUFF (or other models) for secondary $PM_{2.5}$ in long-range applications for both increases and decreases in SO_2 and NO_x
  - Application of local/regional background levels in a regulatory context