

Light Scattering by Fine Particles During PAQS: Measurements and Modeling

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Introduction / Motivation

- Fine aerosol particles scatter light efficiently and contribute to visibility reduction and climate change
- Mass composition and size distribution determine the optical characteristics of the aerosol.
- What are the main causes of visibility degradation?
- How good are the current models to predict the scattering coefficient?
- What are the main contributors to visibility degradation?

Approach

Calculate light-scattering using two methods:

- 1) Thermodynamic model using Mie theory
 - Uses size distributions of individual compounds
 - Solves for equilibrium of aerosol species and water
 - Uses Mie theory calculations to estimate light-scattering
- 2) Fixed scattering efficiencies for compounds and the inclusion of measured aerosol water content

Compare observations with estimated light-scattering

Results

- Thermodynamic model coupled with Mie theory fails to explain the scattering coefficient measured (Fig.1).
- The inclusion of ambient water aerosol concentrations in the scattering coefficient calculations shows better agreement with measurements (Fig.2)
- Discrepancies of the model suggest other compounds (such as organic compounds) are contributing to water uptake into the aerosol phase.
- Sulfate, water and organics are the main aerosol components contributing to light-scattering in Pittsburgh, PA (Fig.3).

Acknowledgements

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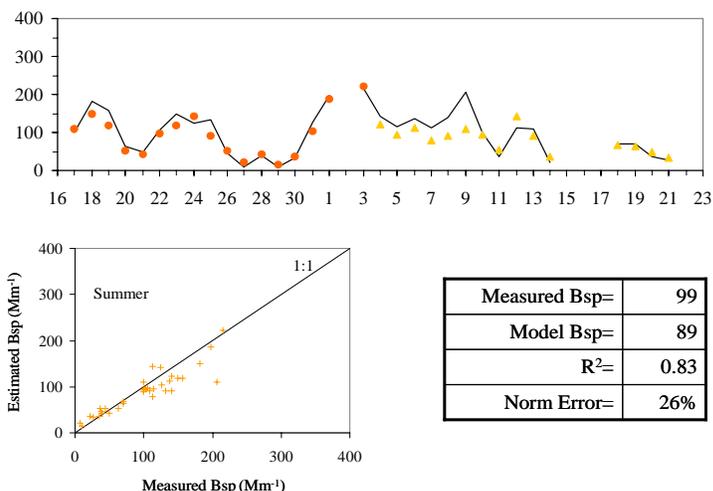


Fig.1 Thermodynamic model vs. observations

$$Bsp = 3 \cdot [SO_4^{2-}] + 3 \cdot [NO_3^-] + 4 \cdot [OM] + 1 \cdot [SOIL] + 3 \cdot [Water]$$

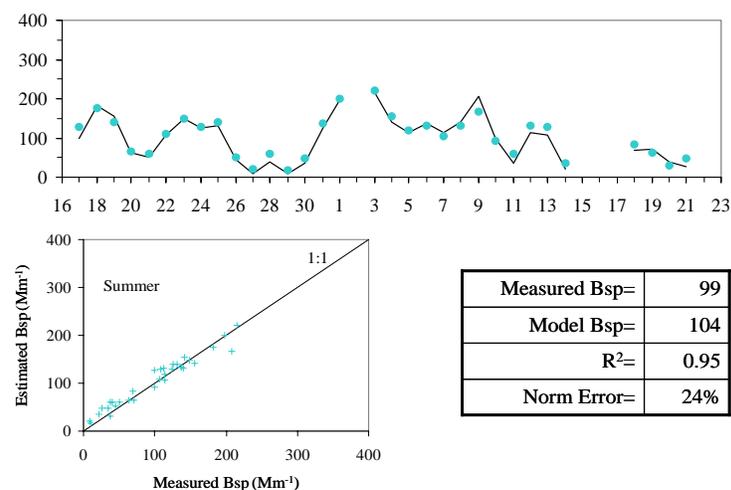


Fig.2 Estimates using measured water vs. observations.

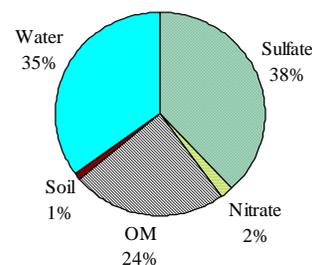


Fig.3. Scattering budget in Pittsburgh, PA