Multi-instrument Quality Controlled Aerosol Optical Properties: Photoacoustic, Nephelometer, PSAP & SP2
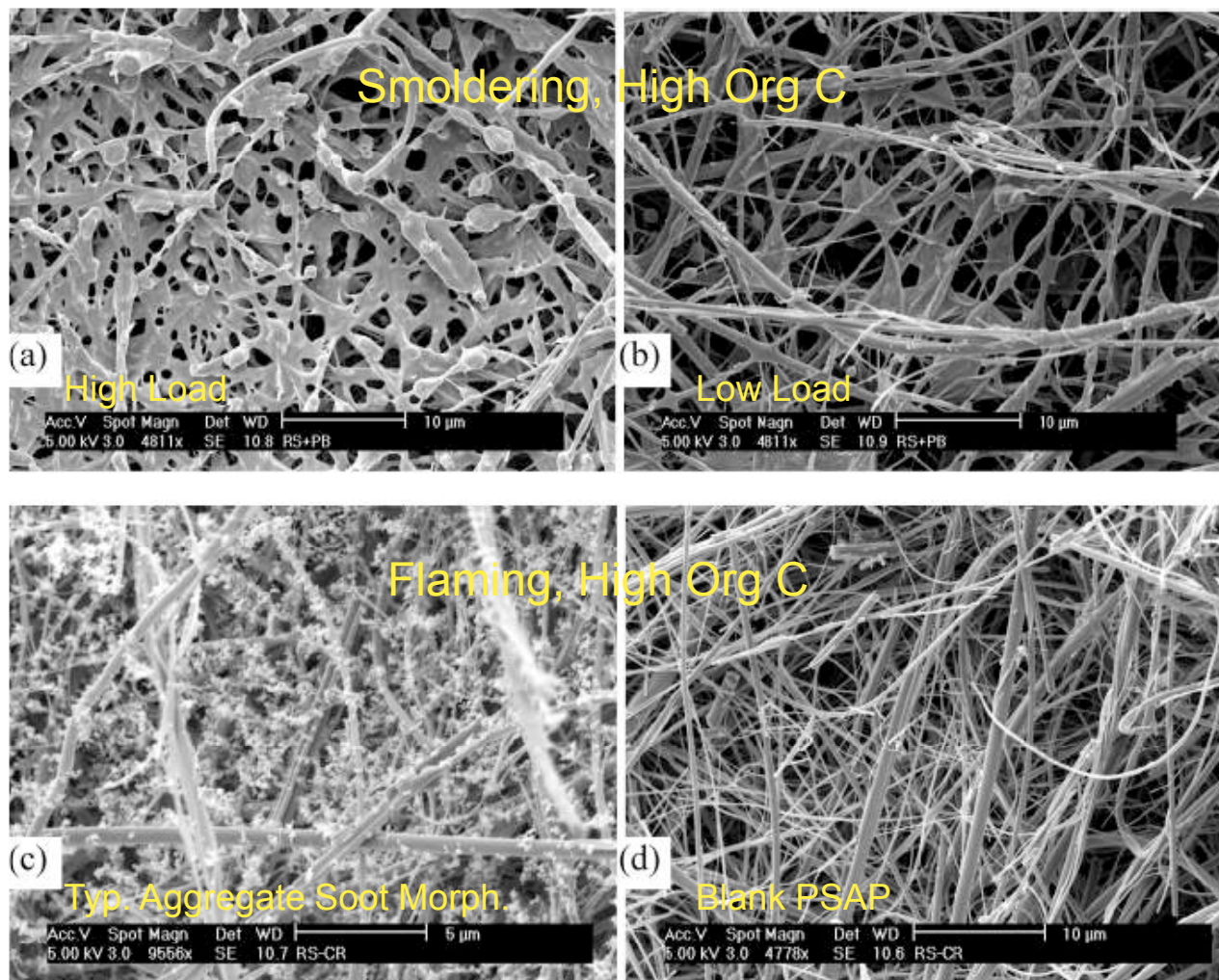
M. Dubey, A. Jefferson, D. Lack, P. Arnott, T. Bond, A. Sedlacek, C. Mazzoleni and B. Flowers
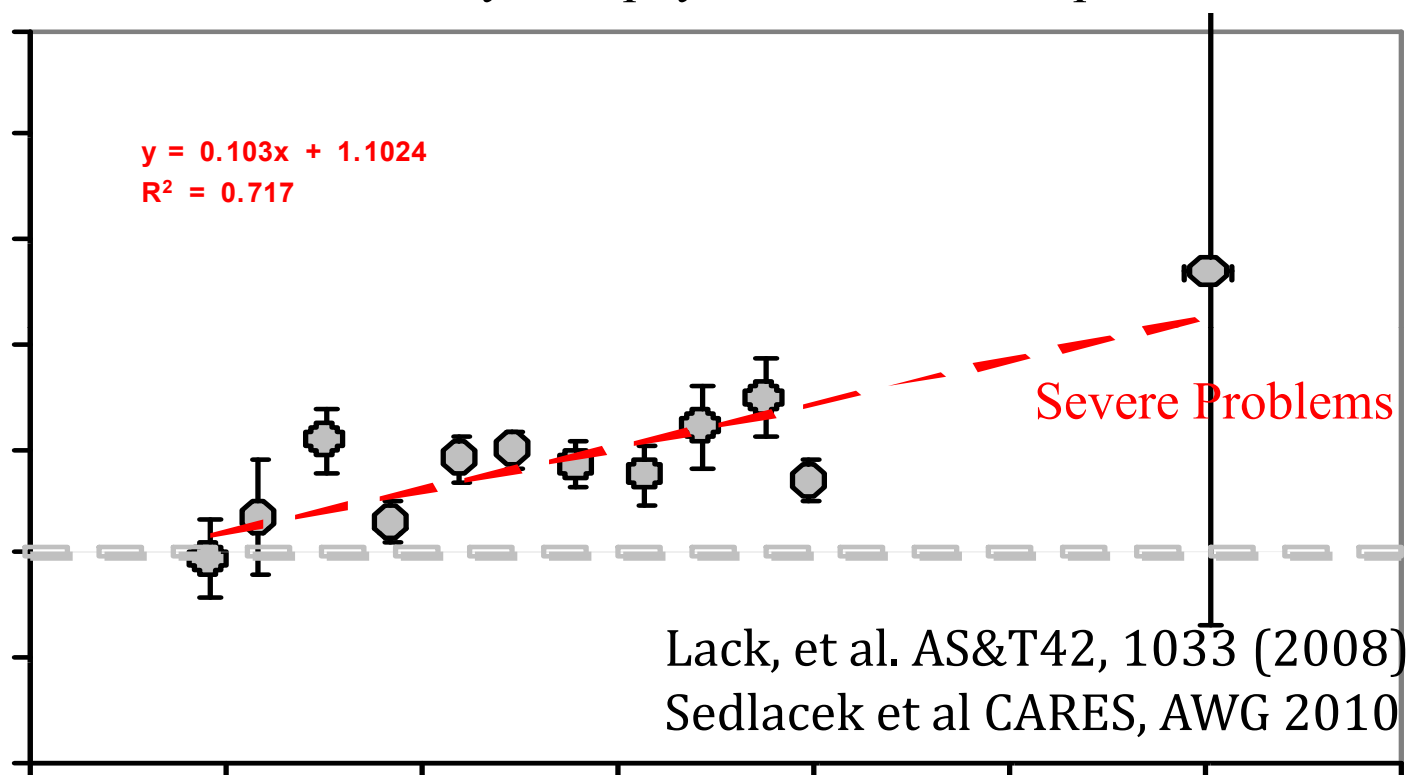
VAP Aerosol Optical Properties

AWG, ASR, Boulder, October 2010

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Traditional Filter Based Absorption Measurements: SEM of PSAP filter samples of rice-straw burning in the laboratory suggest problems

Subramanian et al, Yellow Beads and Missing Particles: Trouble Ahead for Filter Based Absorption Measurements, Aer. Sci. & Tech. (2007), 41: 630-637
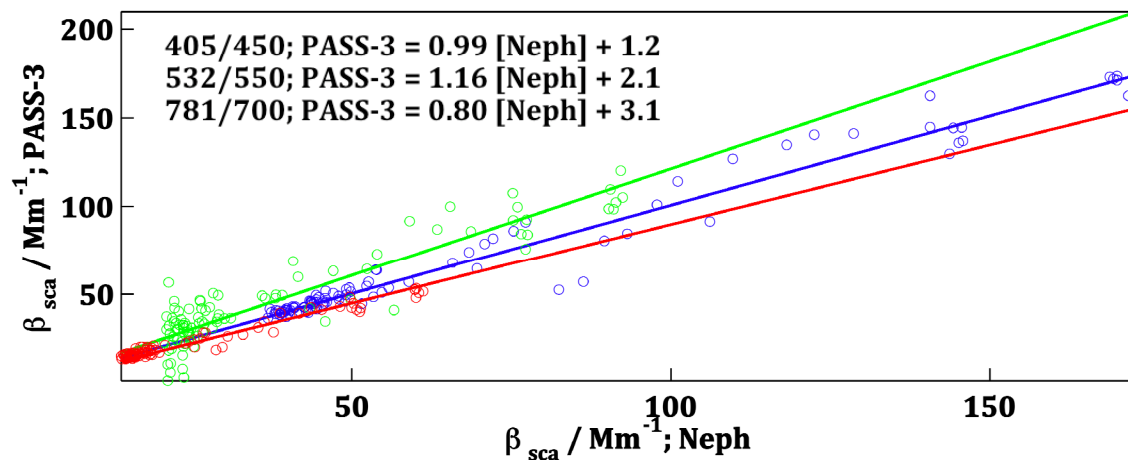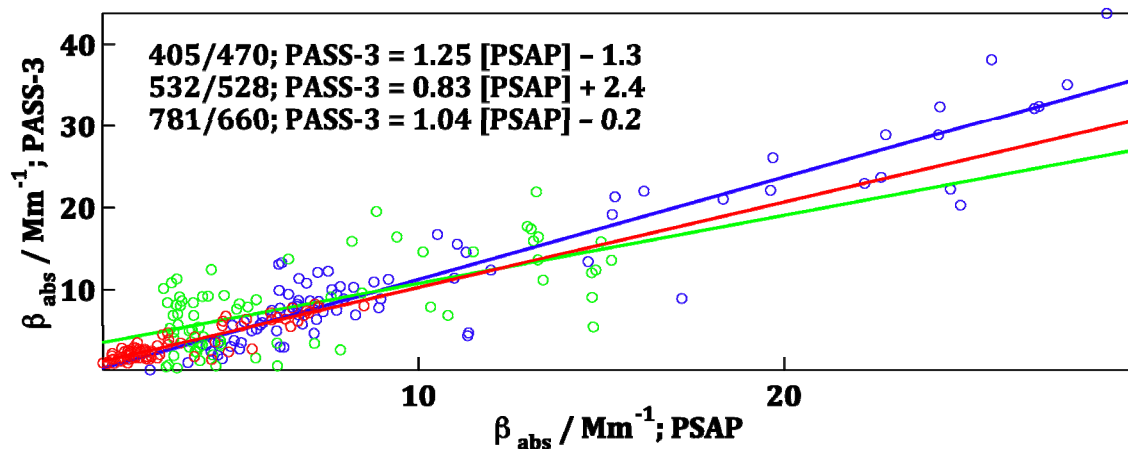
Houston Texas '06: PSAP/PhotoAc Abs. vs AMS Organic

Mazzoleni, Dubey, Murphy, Seinfeld et al unpublished 2006

y = 0.103x + 1.1024
R^2 = 0.717

Severe Problems

Lack, et al. AS&T42, 1033 (2008)
Sedlacek et al CARES, AWG 2010

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Filter based methods can suffer from large systematic high bias under certain conditions (high org, sulf, water, large particles). VAP filter for quality and correction scheme

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Preliminary SGP Analysis: PASS-3, Neph, PSAP

405/470; PASS-3 = 1.25 [PSAP] − 1.3
532/528; PASS-3 = 0.83 [PSAP] + 2.4
781/660; PASS-3 = 1.04 [PSAP] − 0.2

405/450; PASS-3 = 0.99 [Neph] + 1.2
532/550; PASS-3 = 1.16 [Neph] + 2.1
781/700; PASS-3 = 0.80 [Neph] + 3.1

March '09

Agree to <20% for this period at SGP

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Absorption Bias Vs Scattering and Absorption
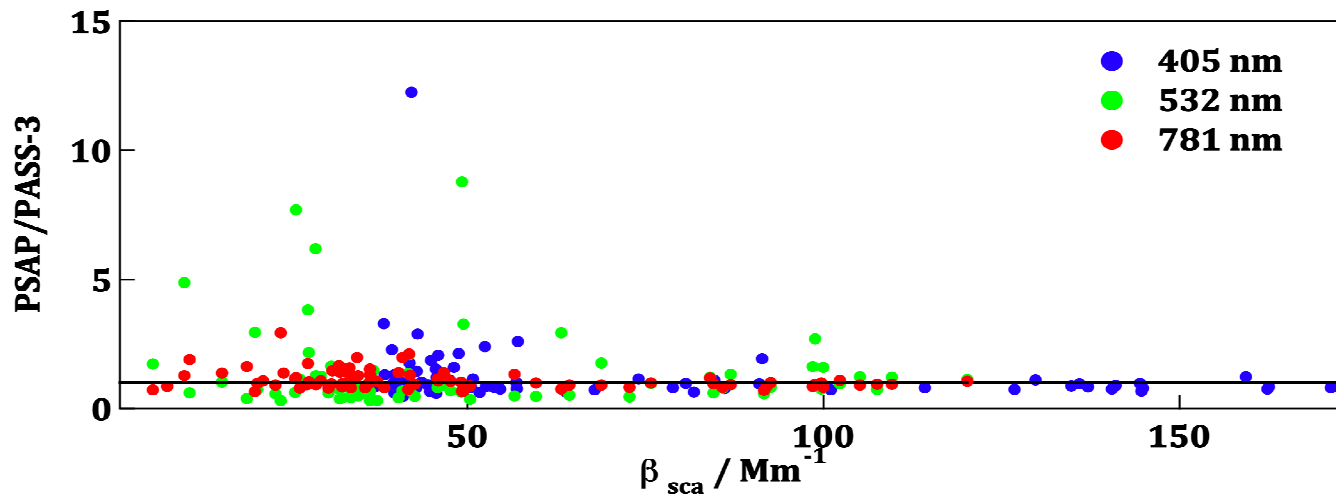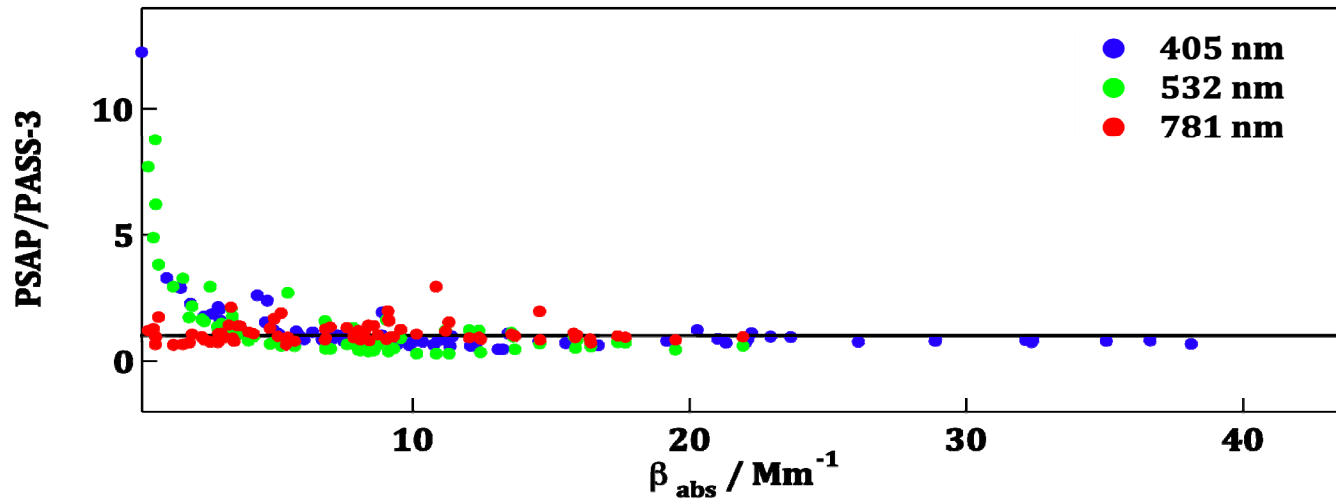
SSA Inter comparison PASS vs PSAP/Neph
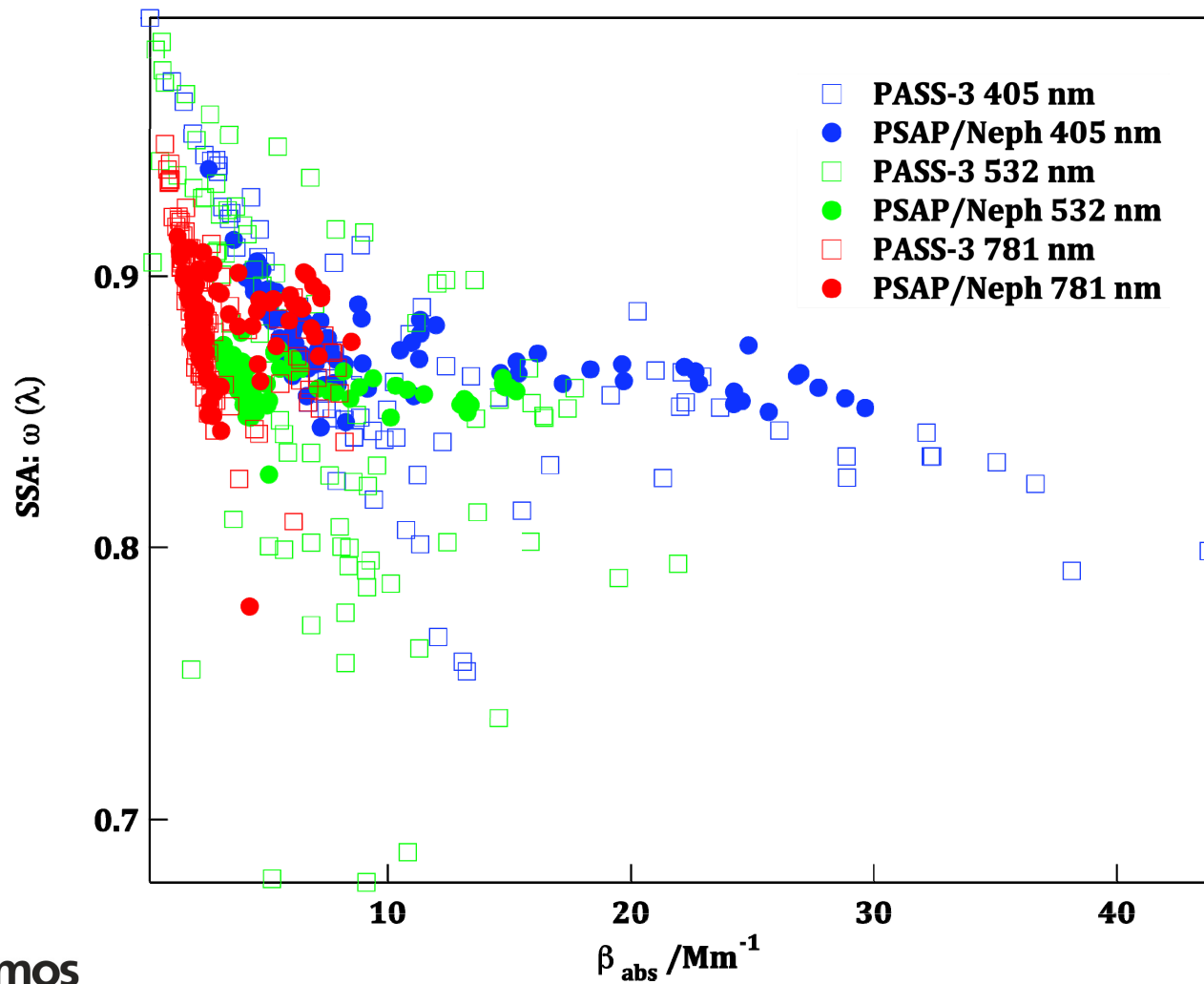
Best of All

- ## Nephelometer
  - Direct Scattering, f(RH), Seconds

- ## PASS-3
  - Direct Absorption, Scattering, direct-SSA, Minute
  - PASS-3 405, 532, 781 nm
  - PASS-UV (355nm-LANL, 375nm-UNR)

- ## PSAP
  - Filter Absorption, Seconds, Potential Biases
  - 467, 532, 670

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Harness SGP-Instruments: VAP AOS

- Nephelometer (Scattering)

- Photoacoustic (Scattering and Absorption)

- PSAP (filter, absorption), CLAP

- APS-size (0.8 to 10 micron)

- CCN

- HDMA

- SP2* (Soot mass)

- ACSM* (Chemical Composition)

- SMPS** (small sizes)

VAPs (~minute, variability, closure, mechanism)

- Multi instrument scattering/absorption comparison for quality controlled optical property VAP to test climate models
  - Use PASS/PSAP (2 minute) = 1 (+/- 10-25%) to filter good data
  - Use PASS/PSAP (2 minute) = 1 (+/- 50%) to lower quality data

- Noise, Bias, Time Resolution Issues
  - Use PSAP, when no bias exists, to get finer time resolution product
  - Reliable and higher time resolution MACs using SP2

- What effects biases and/or artifacts in PSAP?
  - Composition (Organics, Sulfate etc.)
  - Size (<300nm seems to have low filter bias)

- How can we first remove and the correct for the biases?
  - Focused systematic laboratory side (carbon spheres etc with RT)

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