

Measuring Particle Absorption with the CAPS PM_{ssa} Monitor

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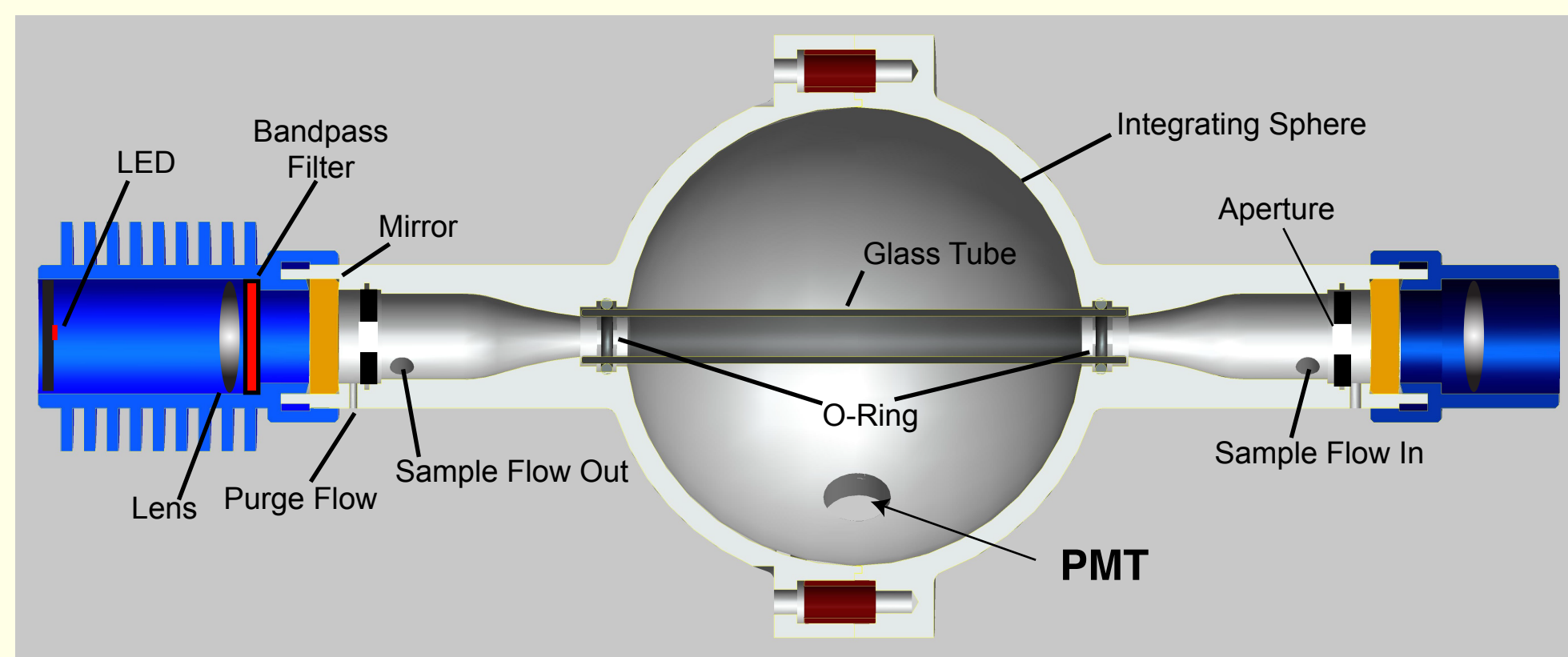
SOOT CONCENTRATION MEASUREMENTS USING THE CAPS PM_{ssa} MONITOR

How

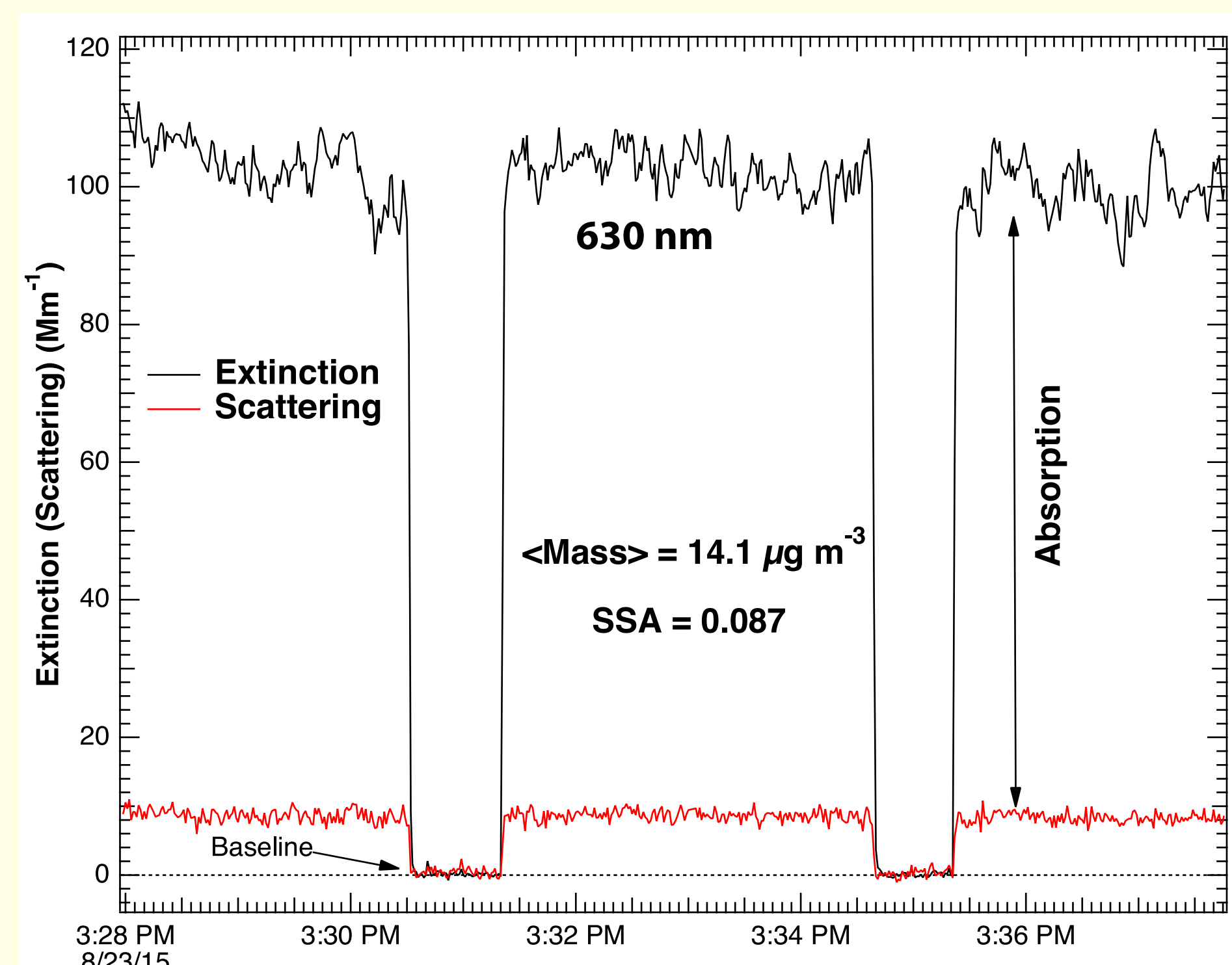
- Incorporates Optical Scattering and Extinction Measurements Using Same Sample Volume
- Minimizes Sampling Errors
- Absorption = Extinction*(1-SSA) where SSA = Single Scattering Albedo
- High Accuracy When SSA is Small (<0.3)
- [M] = Absorption/ MAC (MAC= Mass Absorption Coefficient)

Performance Specifications

- Time Response ~1 s (10-90%)
- LOD (3σ, 1s) = 2 Mm⁻¹ in Both Channels
- Rack Mount, 15 kg, 40 W, 0.85 l min⁻¹ Flow



Optical Data



ENGINE SOOT COMPLIANCE MONITOR (ESCOM)

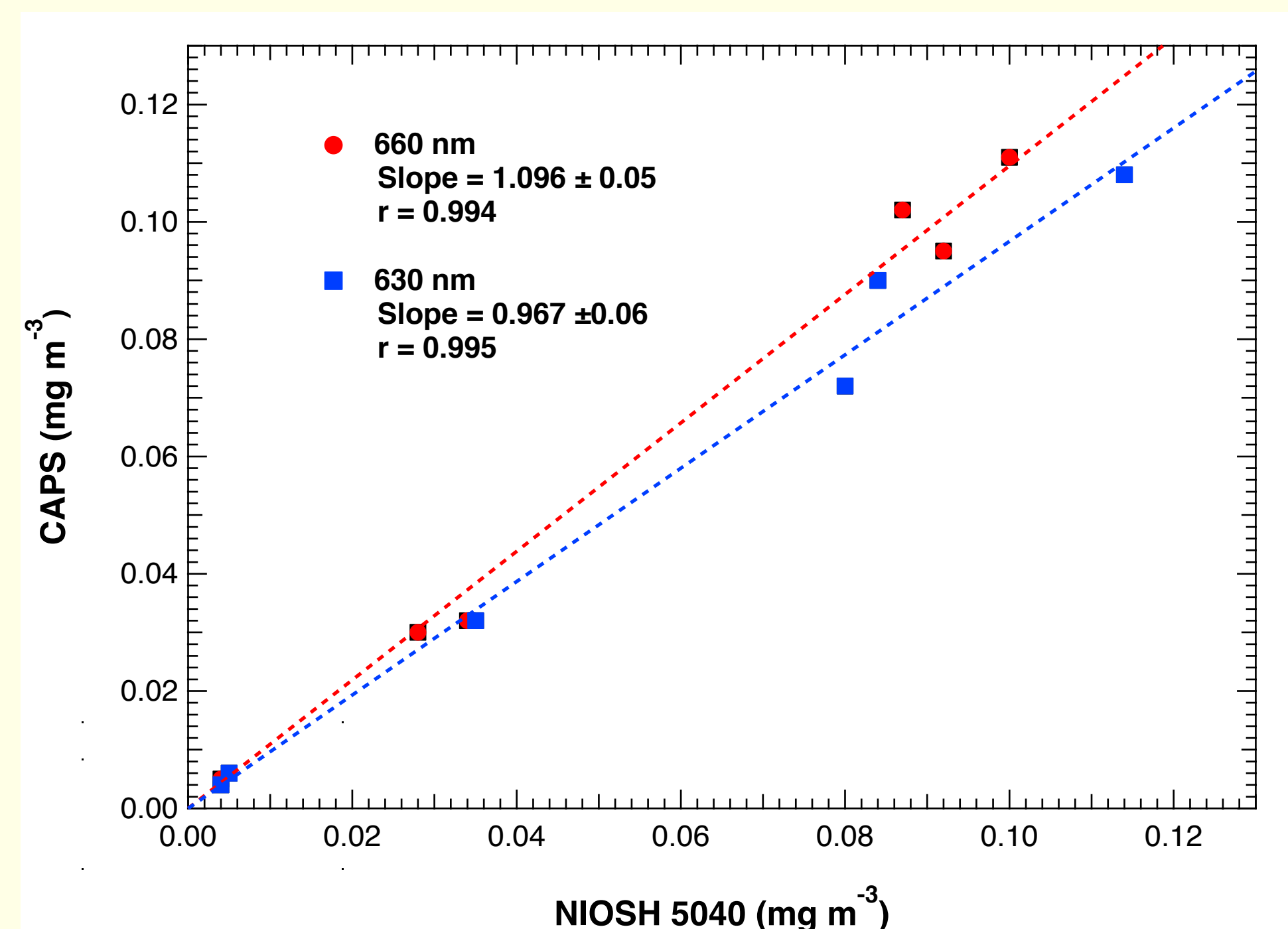
Development of a Monitor To Meet the AIR 6241 Standard for Measurement of Aircraft Engine Soot

- CAPS PM_{ssa} Provides Real-Time Measurement of Aerosol Absorption by Measuring Total Optical Extinction and Single Scattering Albedo
- Soot Mass Derived from Absorption Measurement
- Can It Meet Accuracy Specifications Under Real World Conditions?

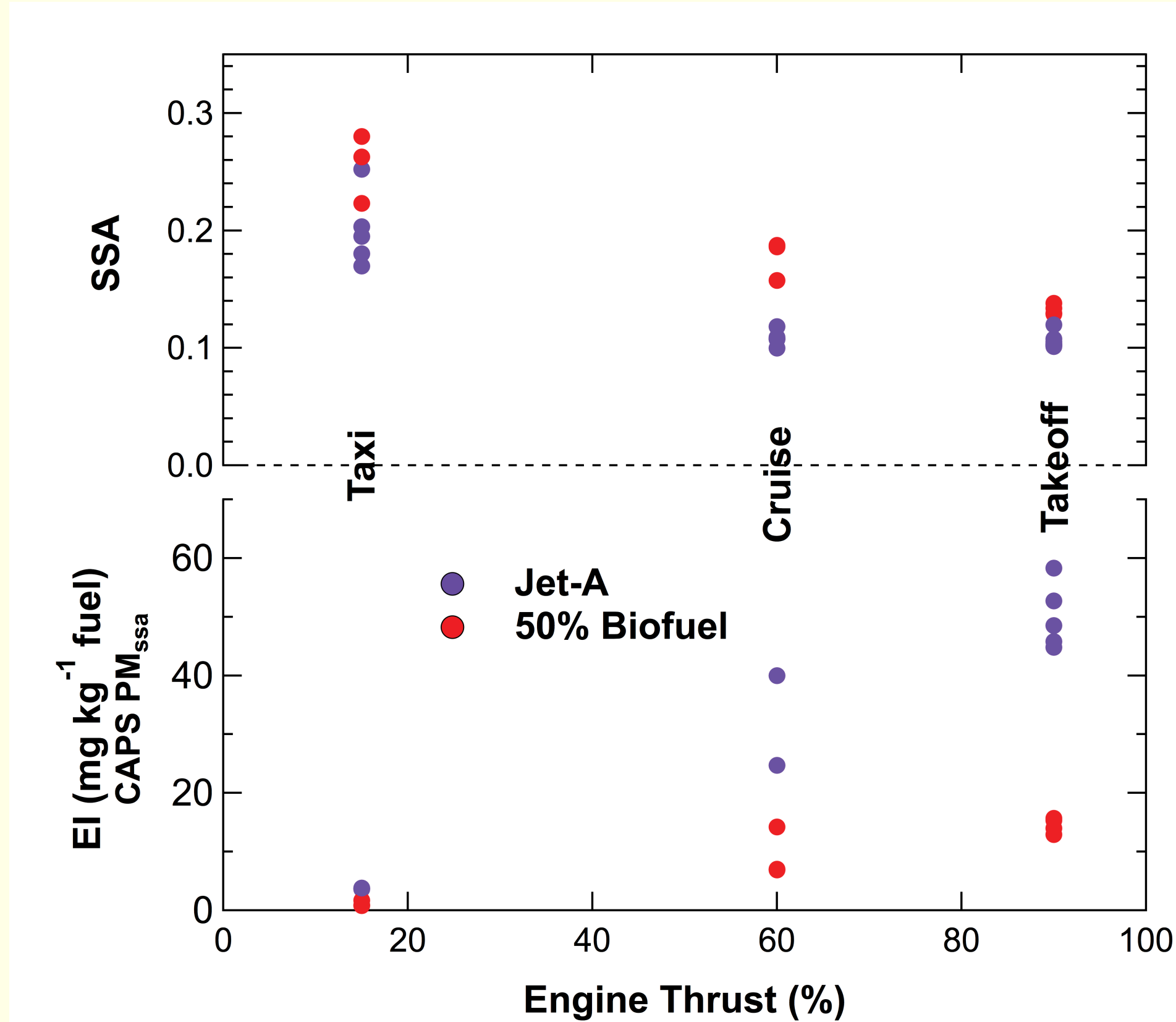
VARIAnT2 Details

(VARIABLE RESPONSE IN AIRCRAFT nvPM TESTING)

- Held August 17-31, 2015 at AEDC/ UTSI Propulsion Research Facility, Tullahoma, TN
- Probe configuration: 4 parallel probes (one to each system, one for "near source" particle sizing and mass determination, and another for smoke number measurements)
- J85-GE-5 Turbojet
- Jet-A (w/AF additives) and 50/50 Camelina blend mass concentrations ranging from ~ 5 to 110 µg m⁻³ at the instrument
- Camelina fuel blend to achieve lower mass concentrations and alter organic carbon content of PM



Engine Soot Properties as Function of Fuel Type



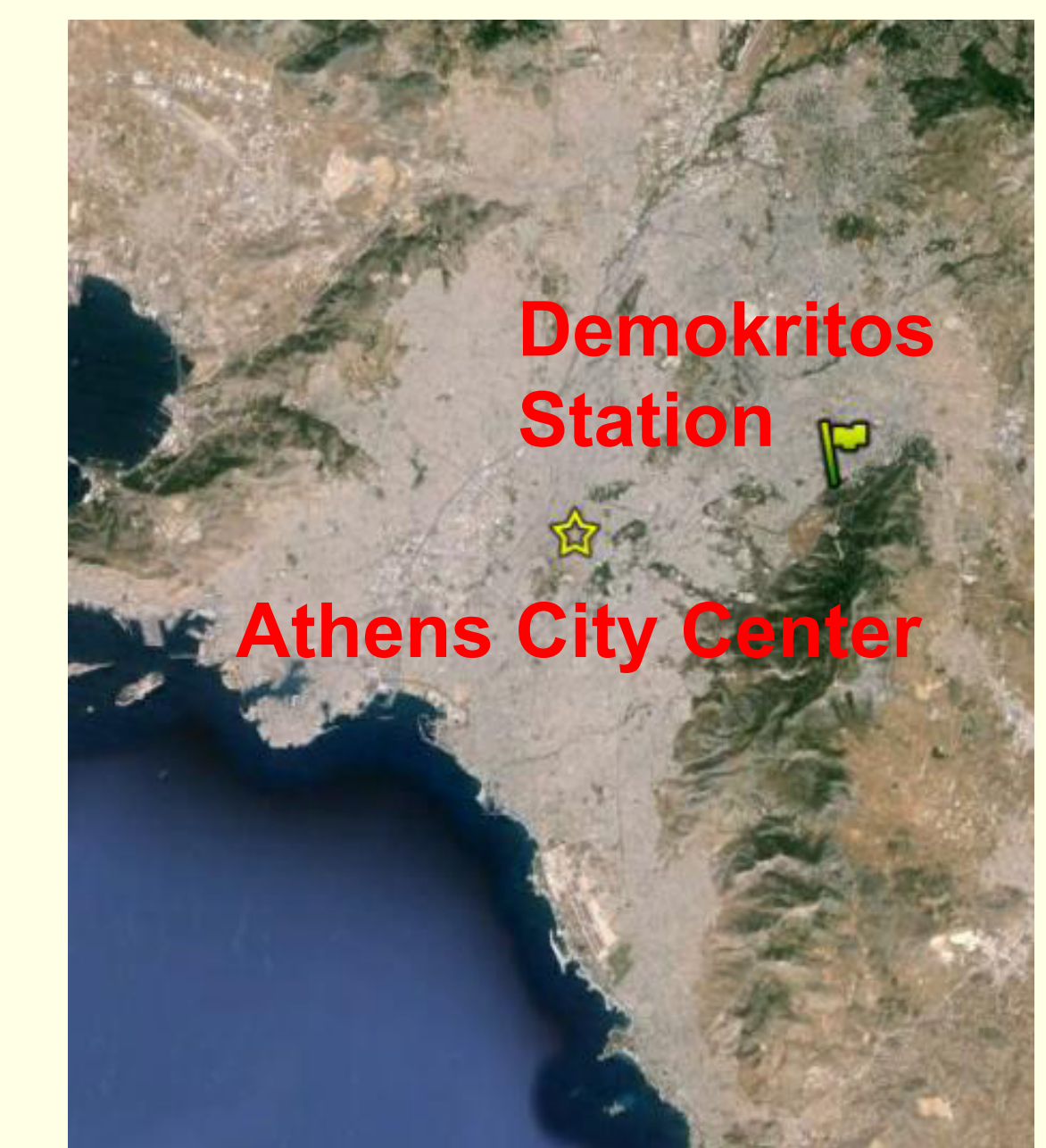
- Biofuel Mixture Appears to Produce Less Soot per Mass Fuel Burned at All Thrust Levels
- Soot from Biofuel Mixture Exhibits Higher SSA than Soot From Jet-A Fuel

CONCLUSIONS

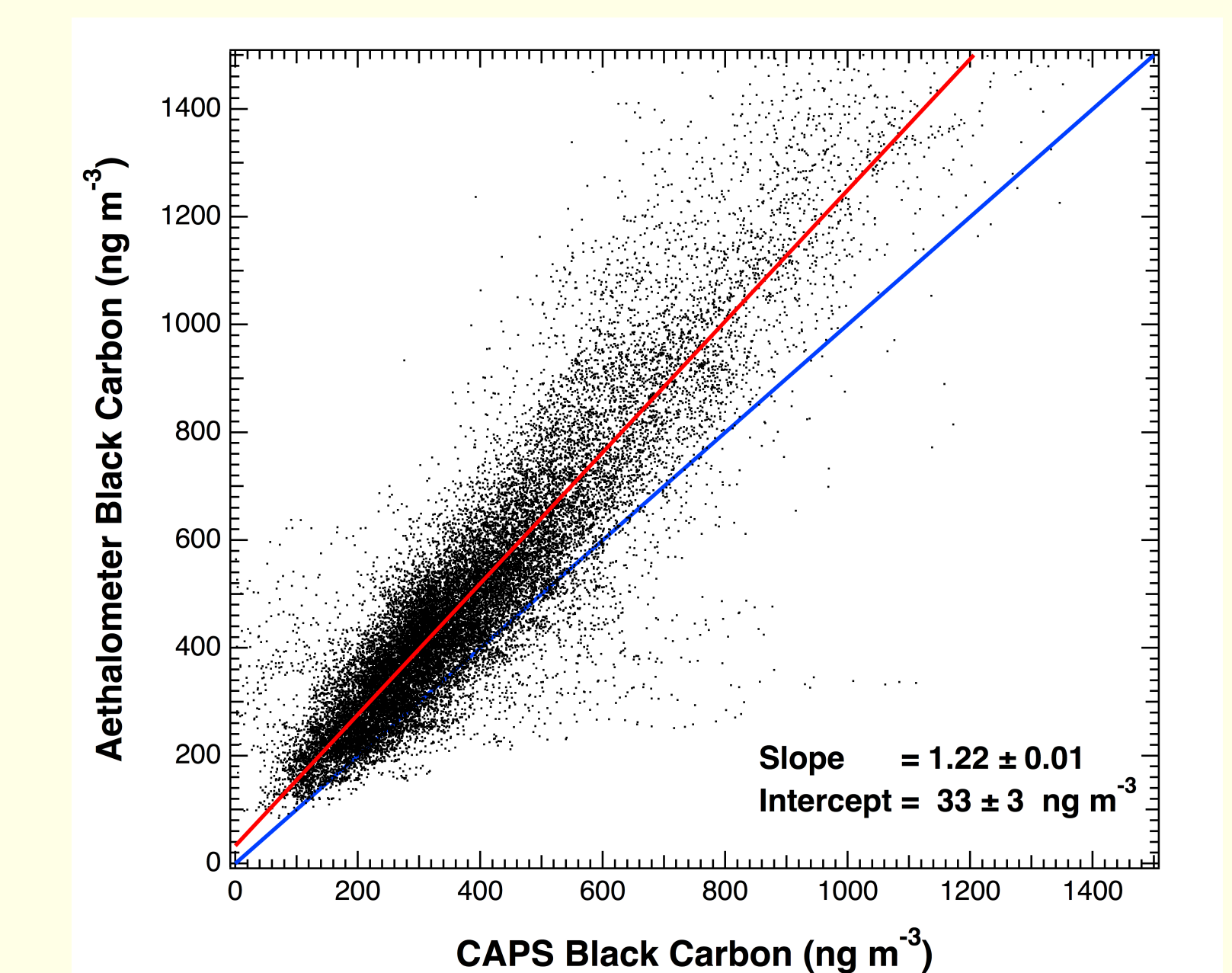
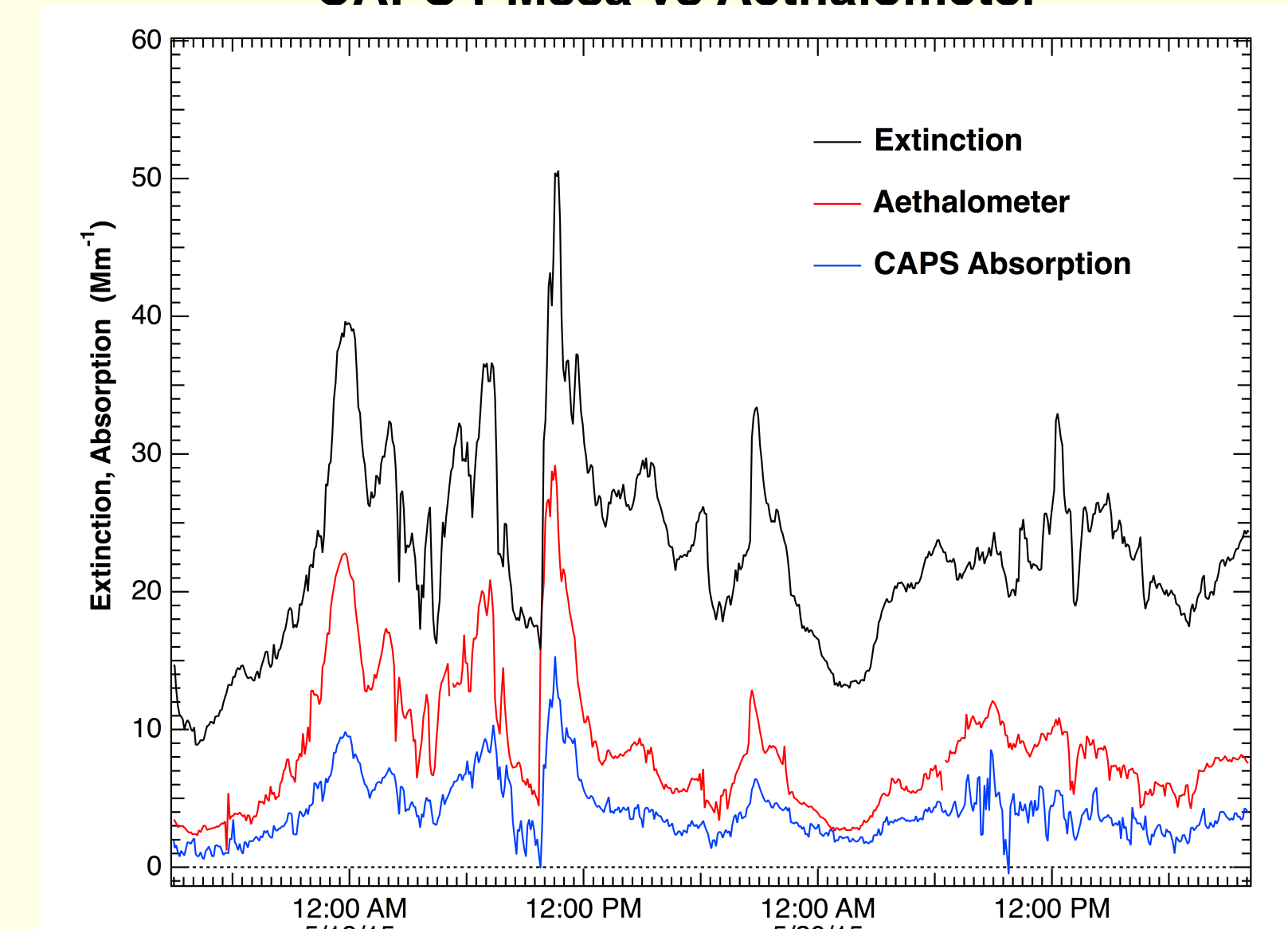
- CAPS PM_{ssa} Monitor Agrees with NIOSH Method 5040 for the Measurement of Soot Concentration
- Current Development:
 - Incorporation of CO₂ Monitor to Provide Real Time Soot Emission Index Information
 - Undergoing Further Testing in Variant3 Campaign National Vehicle and Fuel Emissions Laboratory (EPA) Diesel Engine - SSA = 0.15 ± 0.02 University of Tennessee Space Institute Jet Engine SSA ~ 0.10 (30 nm) APU Engine SSA ~ 0.13 (65 nm)

MEASURING AMBIENT ABSORPTION *

NCSR DEMOKRITOS - ATHENS, GREECE



CAPS PM_{ssa} vs Aethalometer



* In collaboration with Kostas Eleftheriadis NCSR Demokritos, Athens, Greece