



# P-3B Aerosol Measurements for D-AQ

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## Langley Aerosol Research GroupE (LARGE)

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# Faces You'll see in the Field





# LARGE DISCOVER-AQ Objectives



- Provide detailed measurements of aerosol optical and microphysical properties and chemical composition
- Archive additional aerosol parameters that can easily be compared to remote sensor data products (Fine mode fraction, AOTs, single scattering albedo, etc.)
- Conduct collaborative studies to explore methods of improving remote-sensor-derived aerosol properties such as size distribution, water content, fine-mode fraction, aerosol type, etc.
- Examine aerosol spatial variability within satellite sensor footprint
- Examine how aerosol properties change with age—CCN,  $f(\text{RH})$ , BC coatings particular areas of focus (with Ga Tech)



# In Situ Aerosol Measurements

Measured Parameter	Instrument	Size Range ( $\mu\text{m}$ )	Response time (sec)	Precision
Hot, Cold, Ultrafine CN	TSI 3025, (2) TSI 3010	>0.003	1	10%
Aerosol Particle Size	TSI SMPS	0.01 – 0.3	60	20%
	DMT UHSAS	0.06 – 1.0	1	20%
	TSI 3321	0.5 – 10	1	20%
Cloud Condensation Nuclei Spectra	Scanning Flow CCN	<	60	-
Total and Submicron Scattering at 450, 550, and 700 nm	(2) TSI 3563	<10	1	$5e-7 \text{ m}^{-1}$
Total and Submicron Absorption at 467, 530, and 660 nm	(2) RR PSAP	<10	5	$5e-7 \text{ m}^{-1}$
Wet and Dry scattering	(2) Radiance Research Neph	<	20	-
Black Carbon Mass/Size	DMT SP2	0.1-0.5	1	20%
Total Organic Carbon	PILS/TOC	>0.01	30	-
Soluble Ion Composition	PILS/IC + Filters	>0.01	240	Varies by ion

Can also provide cloud particle measurements with wing-tip probe if needed

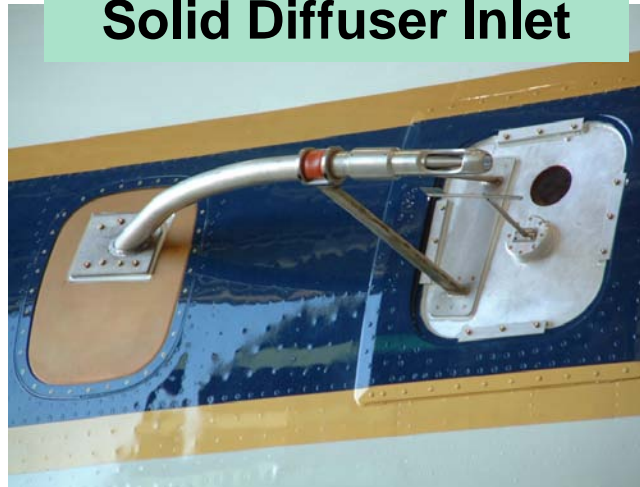


# Instrument Installation

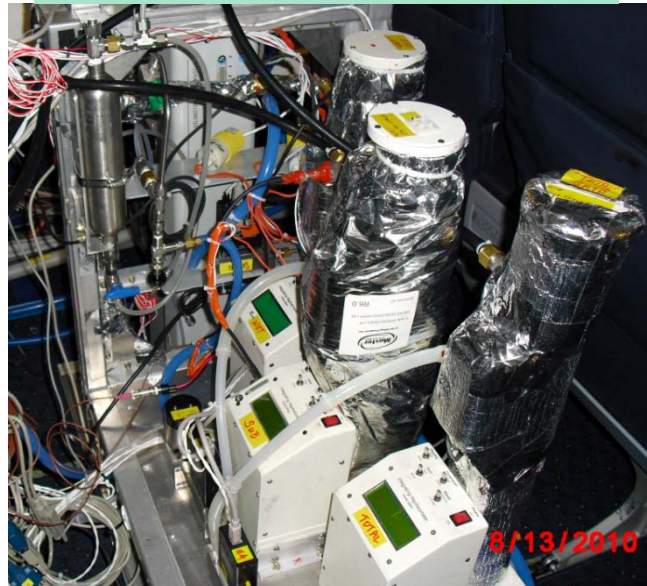
Rear Rack



Solid Diffuser Inlet



Pump/Neph Rack



Forward Rack



17 instruments in 2 racks + floor mounted pump plate;  $\geq 2$  Operators



# Aerosol Data Products

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## Optical

- Wavelength-dependent absorption, scattering and extinction coefficients
- Angstrom exponents for absorption and scattering
- Fine Mode Fraction
- Hemispheric-backscattering
- $f(\text{RH})$  and  $\Gamma$
- Wavelength-dependent and dry/ambient AOT
- Mass extinction efficiency

## Microphysical

- Number densities
- Size Distribution from 0.01 to 10  $\mu\text{m}$
- Volatile CN fraction
- PM1 and PM2.5 estimates
- CCN Spectra + CCN fraction

## Composition

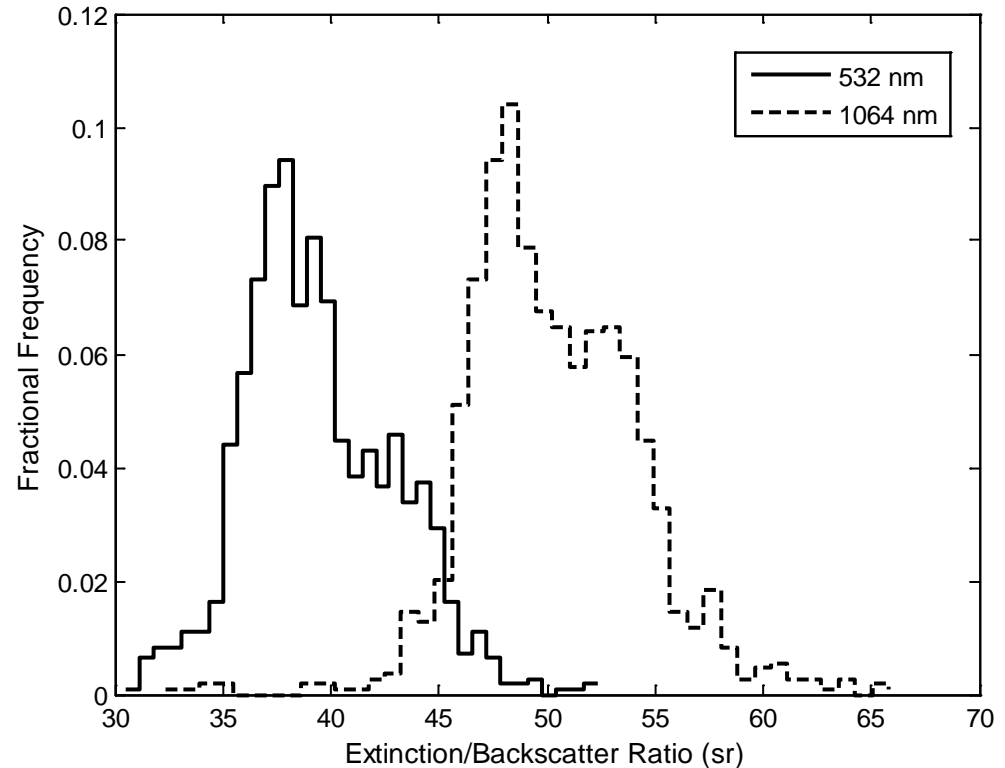
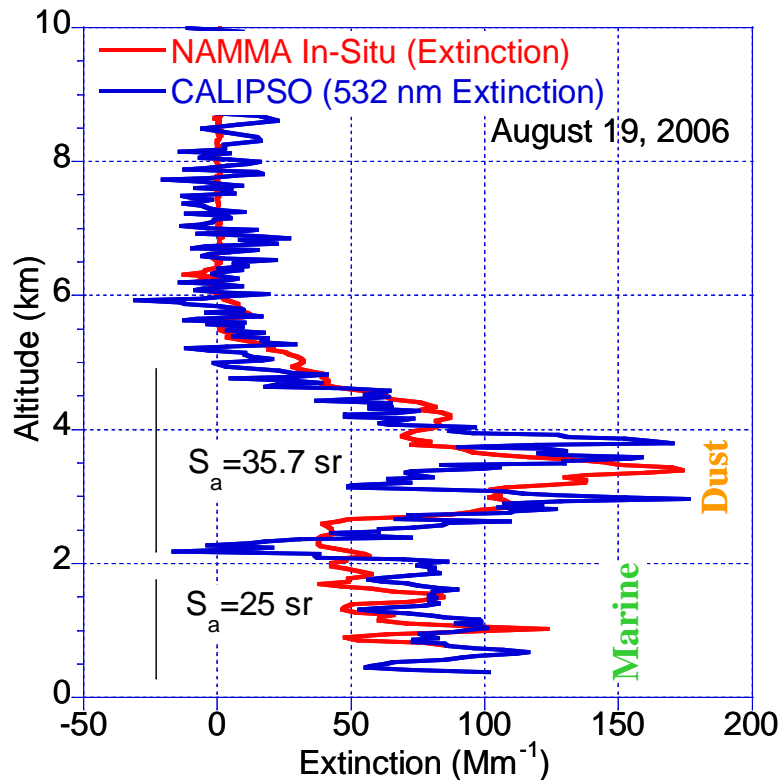
- Black Carbon Mass
- Total water soluble organic carbon (WSOC)
- Water soluble ions:  $\text{SO}_4^{-2}$ ,  $\text{NO}_3^{-1}$ ,  $\text{Cl}^{-1}$ ,  $\text{NH}_4^{+1}$ ,  $\text{Mg}^{+2}$ ,  $\text{Na}^{+1}$ ,  $\text{Ca}^{+2}$



# Example of In Situ -- Lidar Comparison

NAMMA measurements used to constrain Calipso Lidar ratios ( $S_a$ ) for dust

Omar et al., JGR, in press.

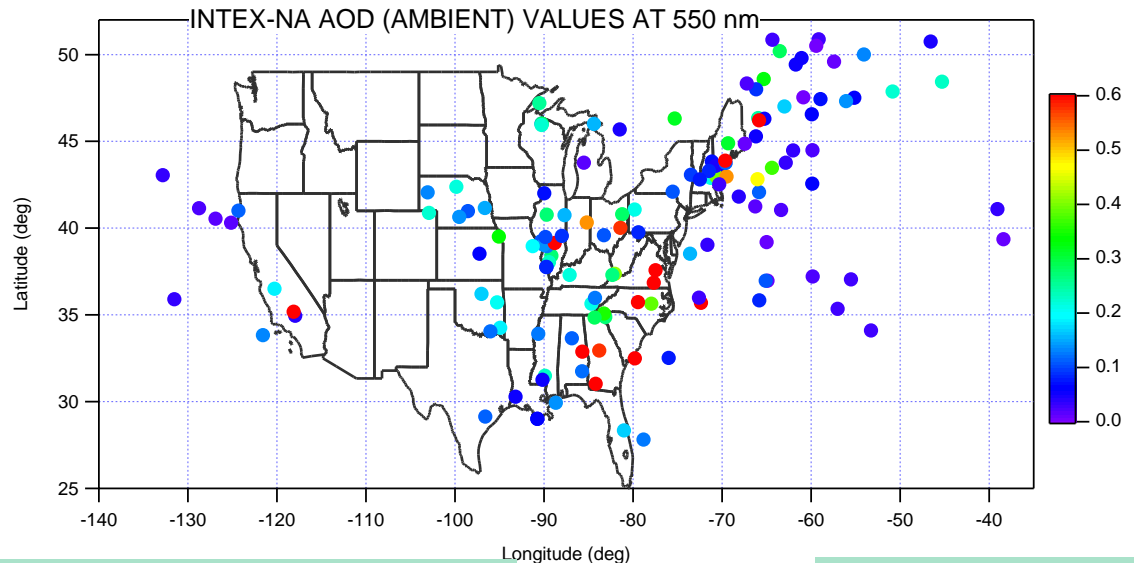


HSRL measures  $S_a$  directly—combined analysis will yield values various aerosol types

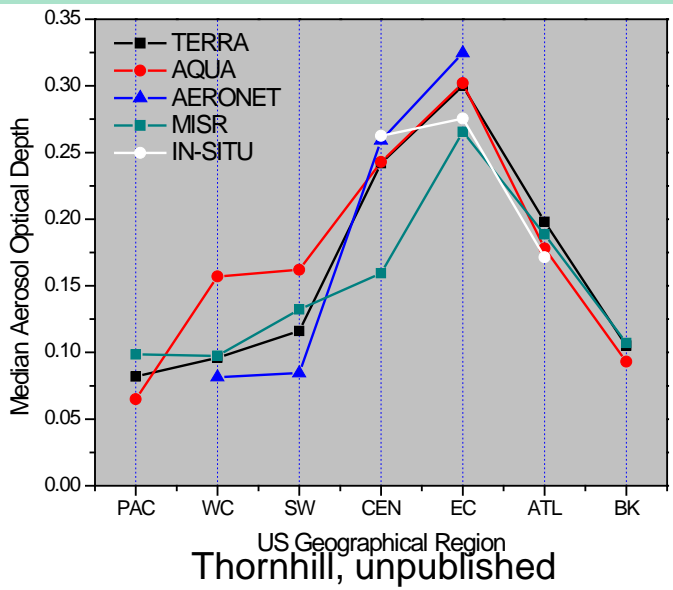


# Examples of In Situ – Modis/AERONET Comparison

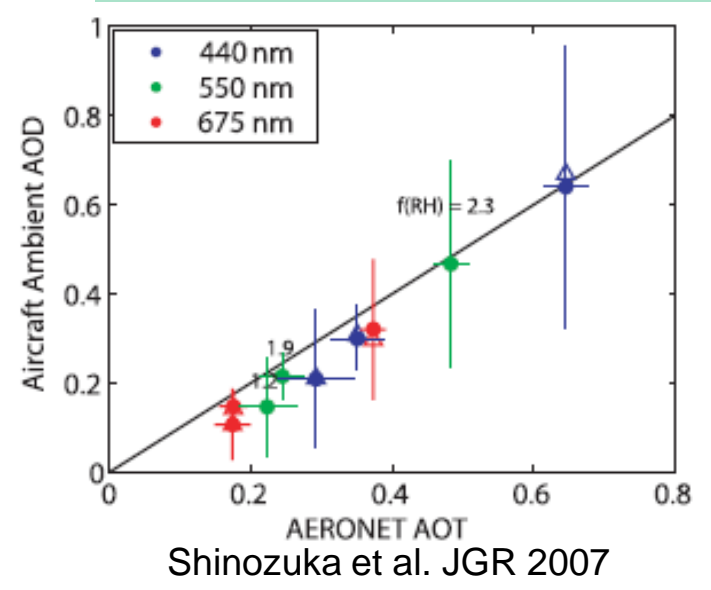
## DC-8 Vertical Profiles during INTEX-NA



## Comparison w/MODIS, MISR, and AERONET



## Comparison with AERONET







# Operational Requirements

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- Base measurement data in real time (T, P, lat, lon, alt, airspeed, etc.)
- Vertical profile ascent/descent rates  $<1000$  fps below 10 kft
- Test flight maneuvers to determine roll angle and airspeed limits
- $\geq 5$  minutes on each level leg to allow time for sample collection
- Avoid clouds when possible
- Permission to be out of seats during flight
- Moderate to fast airspeeds to provide adequate inlet/venturi flow
  
- 1 hour before flight to warm up instruments
- 1 hour after flight to download data, service instruments
- Lab space to set up water system, extract filters
- Refrigerator and freezer at Wallops to store samples



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# Questions?