DC-8 Aerosol Measurements
Preliminary Examples ICARRT - INTEX-NA
Field Science Meeting, Pease, July 24, 2004

HiGEAR
Hawaii Group for Environmental Aerosol Research

University of Hawaii
Hawaii Group for Environmental Aerosol Research
A. Clarke, S. Howell, C. McNaughton, Y. Shinozuka, J. Zhou, V. Kapustin
Dry Size Distributions, Volatility, Aerosol scatter./absorp., f(RH)

Alaska fire plume

A R G E

Langley Aerosol Research Group Experiments
B. Anderson, L. Thornhill, E. Winstead, C. Hudgins, A. Omar
Ambient aerosol size, Cloud droplet size, Aerosol scatter./absorp.

UNH

University of New Hampshire
B. Talbot, J. Dibb, E. Scheuer
Mist Chamber, Ion Chromatography, Filters

GIT PILS

Georgia Institute of Technology
Particle into Liquid Sampler
R. Weber, S. Sandholm, C. Hennigan, Y. Ma
Particle Into Liquid Sampler, Ion Chromatography

Photo Courtesy: H. Fuelberg

In-situ Aerosol Physiochemical Data Needed to Link Optically Derived Satellite Products to Emission (mass) Based Global Models

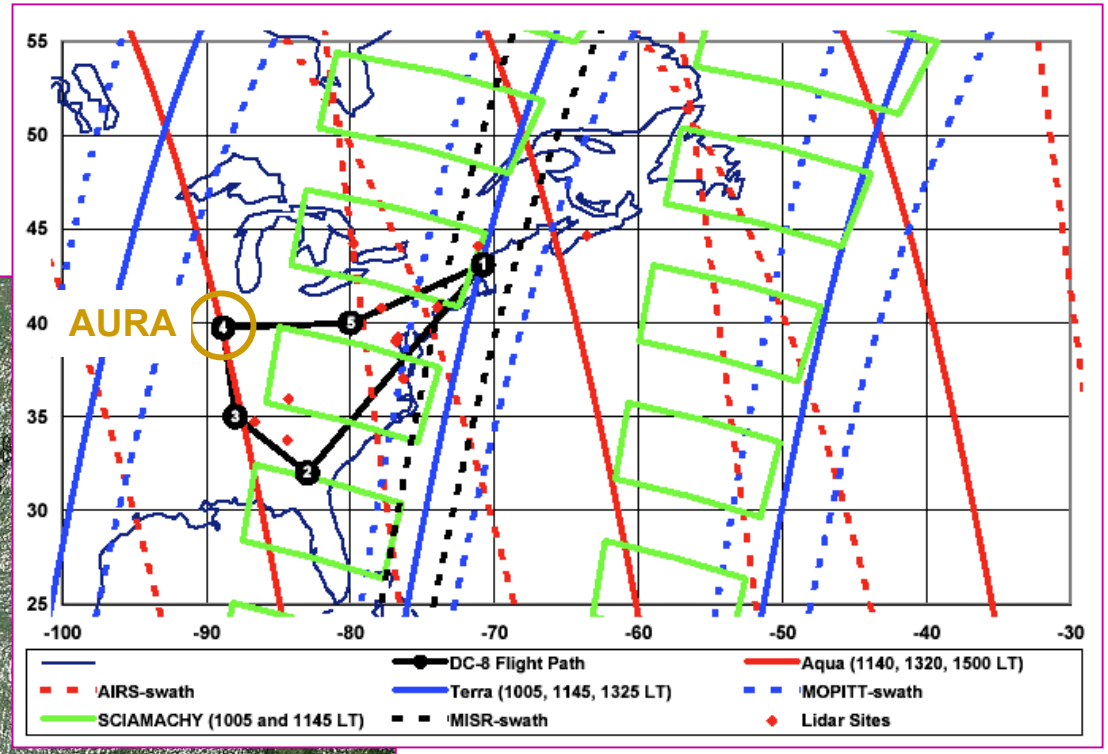
Interpretation of Satellite Radiances Depend on Aerosol Size and Composition

Models Based upon Emissions (Mass) with Estimated Size and mixing etc.

In-situ measurements of Size-Resolved Composition and Associated Optical Properties needed to link Satellite and Model Products on Global Scales.

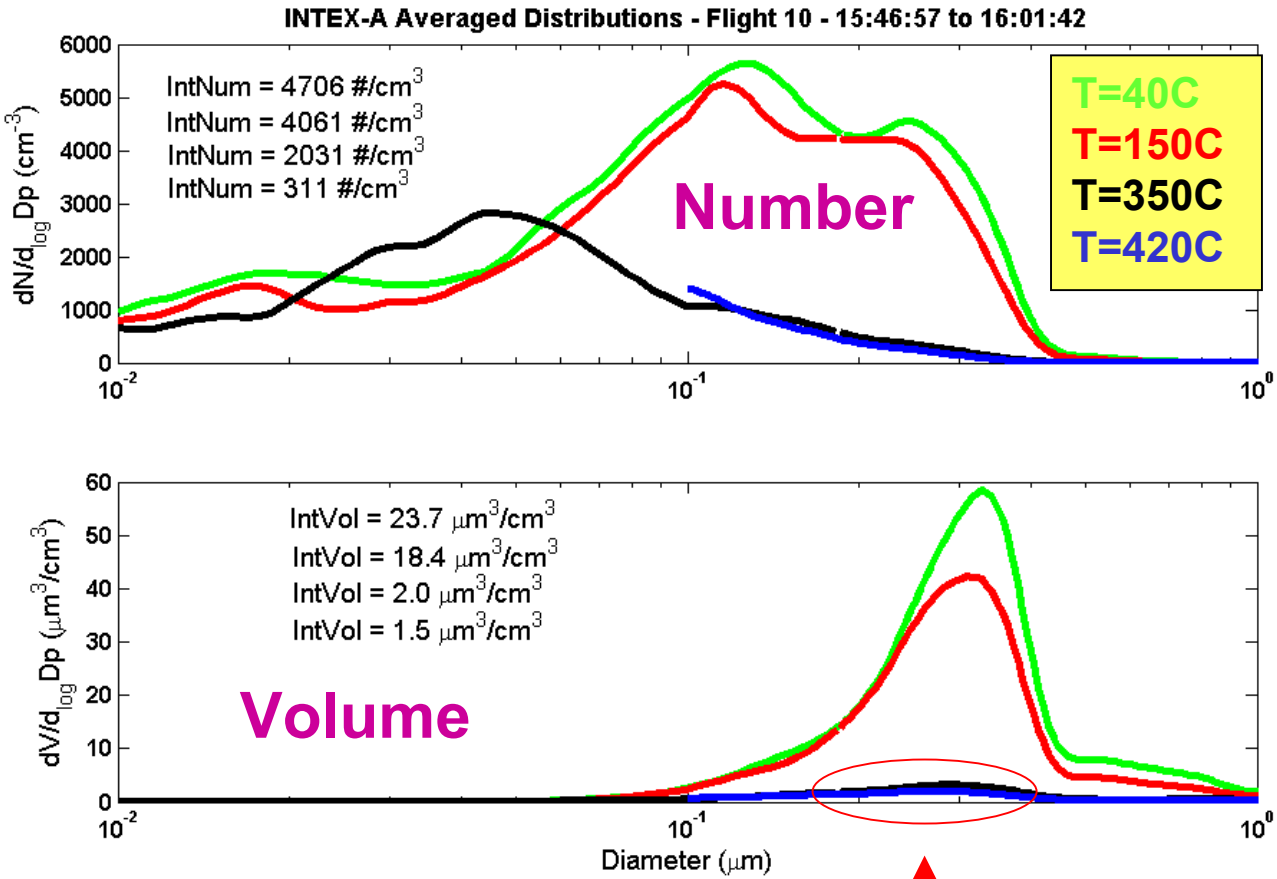
Global Satellite and Model Products Depend on Realistic Aerosol Physiochemistry and Optics for Regional Aerosol Types

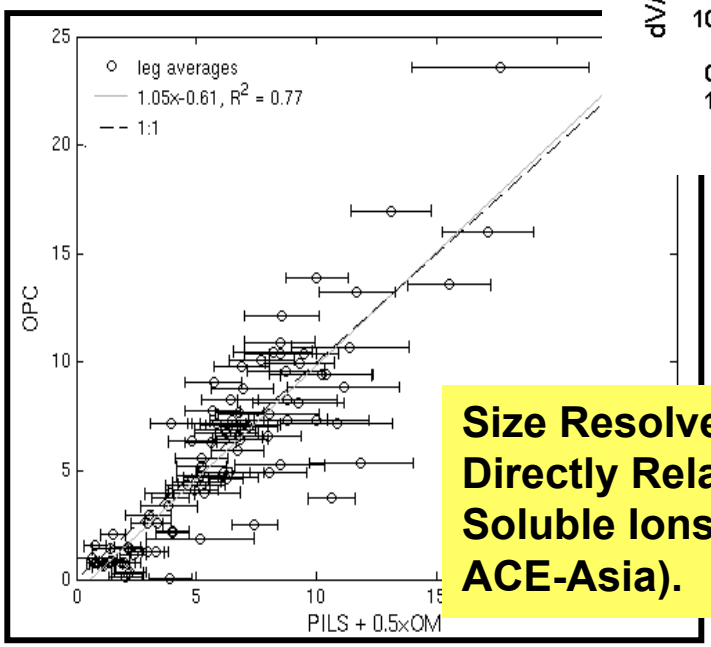
INTEX flight#10 – July 20, 04



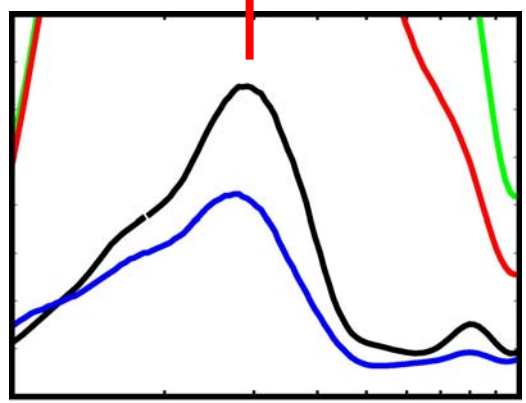
MODIS Image
Biomass smoke over
Regional Pollution

Regional near-surface pollution over SE shows lower BC concentration and smaller sizes





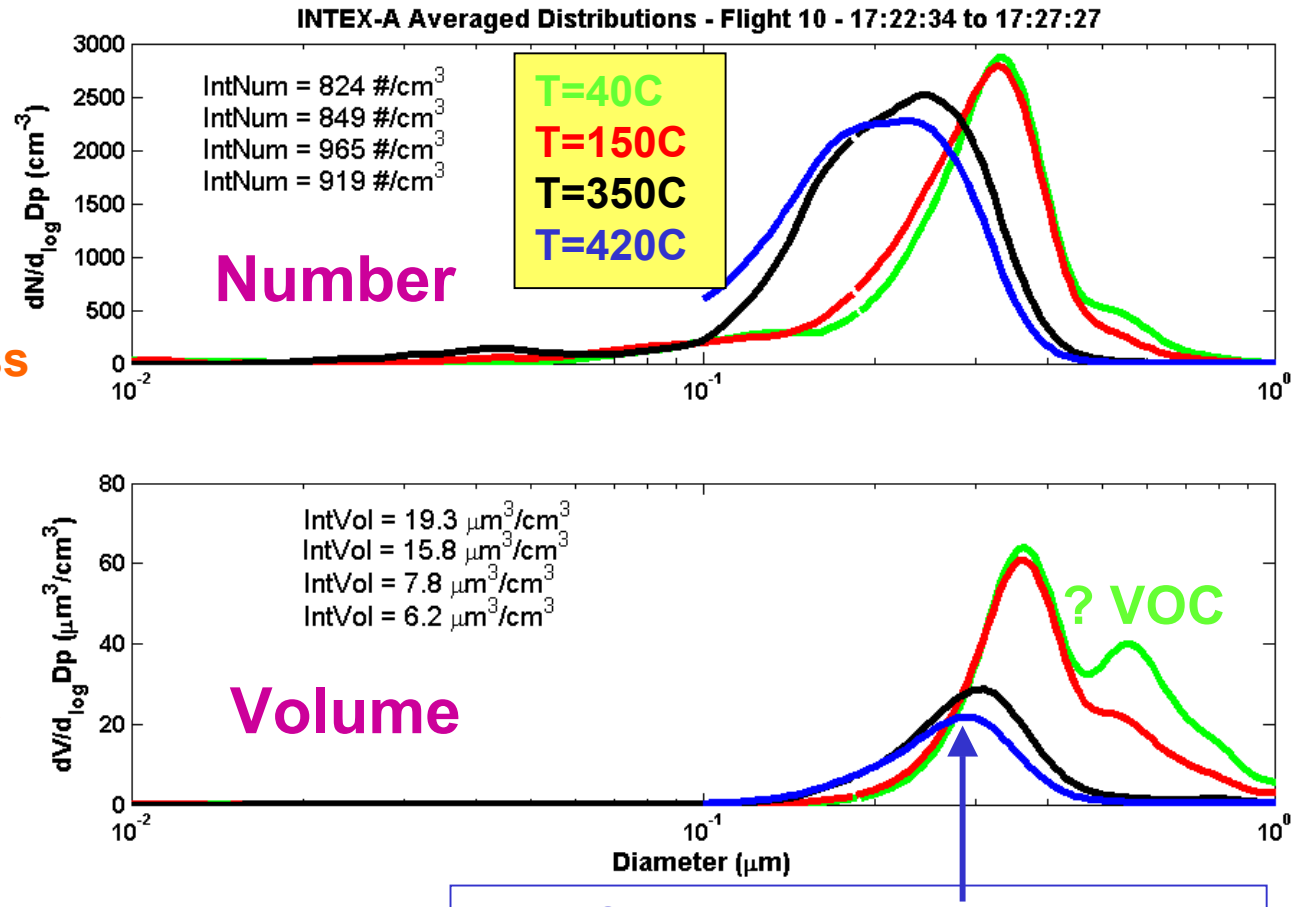
Size Resolved Volatility Directly Related to Soluble Ions (PILS data ACE-Asia).



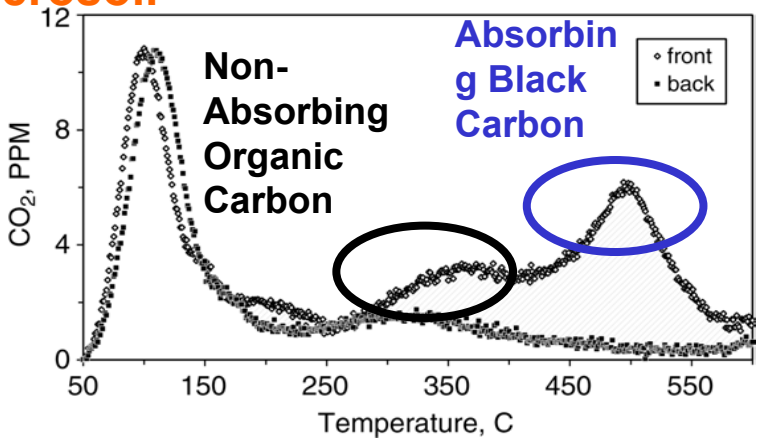
Alaska Fire Pollution

As we find in many combustion aerosol, the refractory (420C) component contains the black carbon (BC). The loss of volume on heating with little change in number indicates most are internally mixed.

BC establishes most CN & CCN number population and acts as condensation site for soluble/volatile aerosol.



Fire BC is appears nearly monomodal with a high-temp OC coating.



Examples of evolved CO2 from front aerosol laden filter (open circles) and back (solid circles) quartz filters (gaseous organic uptake) from INDOEX experiment. Mayol-Bracero et al., JGR, 2002

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How does MASS from aerosol size distribution compare to MASS derived from particle into liquid sampler (PILS)?

$$M_{volatile} = \rho \cdot V_{Total} - \rho \cdot V_{360^o C}$$

Assume volatile aerosol density of 1.5, soot 2.0

$M_{volatile}$ = 1.5 x 23.7 – 2.0 x 2.0 = **31.6** μg/m^3

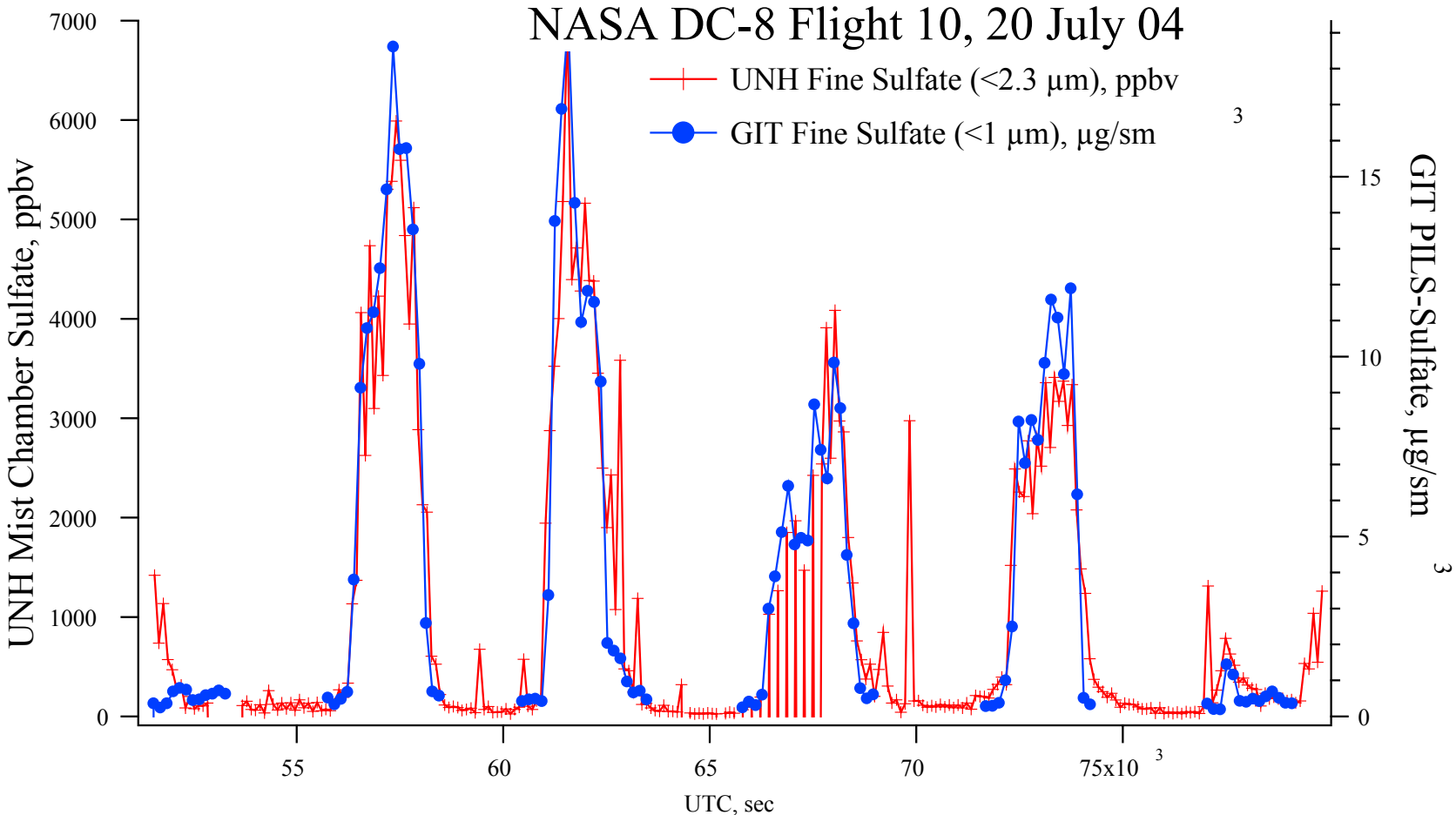
$PILS_{mass} = SO_4^{2-} + NO_3^- + NH_4^+$

$PILS_{mass}$ = **21.4** μg/m^3

MISSING VOLUME (30%) EXPECTED TO BE ORGANICS

UNH GIT PILS

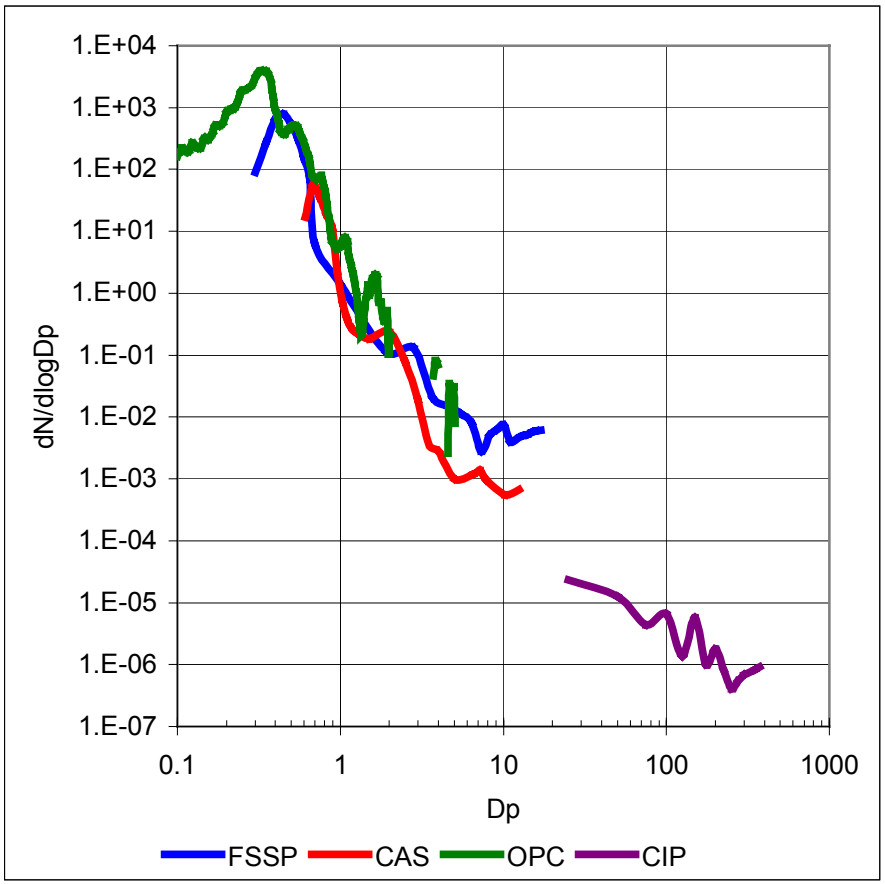
Sulfate Comparison on four vertical profiles to ~8km

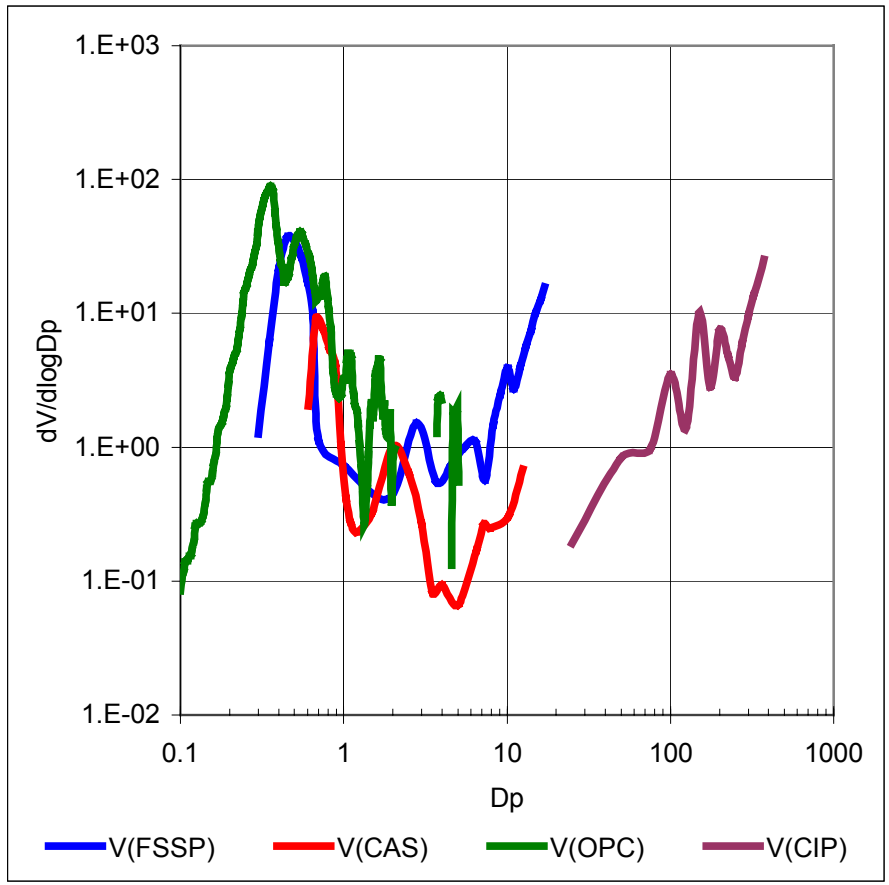


Preliminary Comparison of DC-8 size distributions Wing Probe (FSSP, CAS, CIP) and internal OPC in dry Biomass Plume aloft

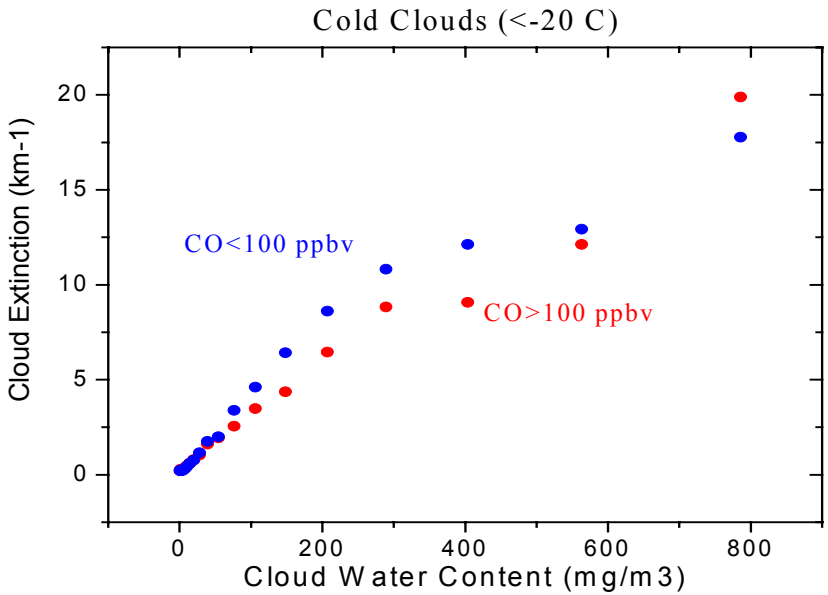
A R G E

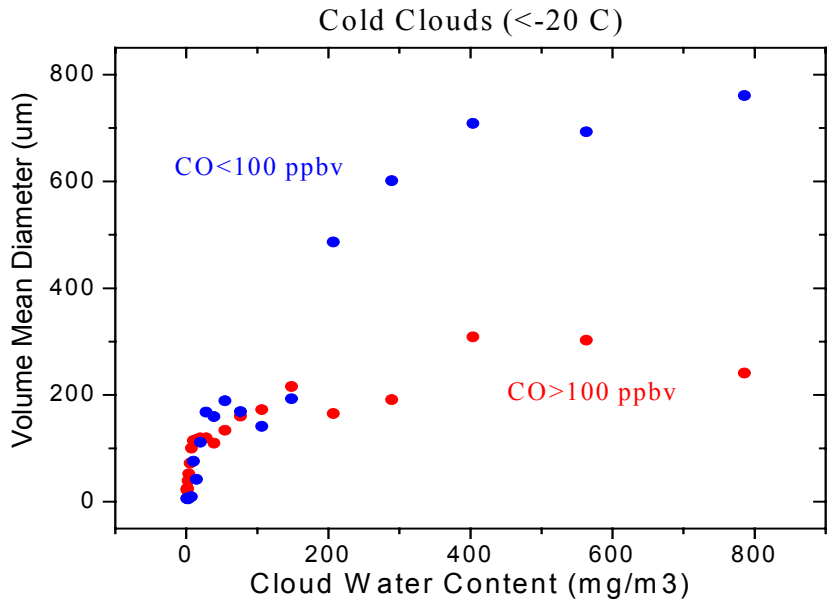
FLIGHT 10 SEGMENT (77300-78750s) 12-14 kft LEG (Biomass Burning Layer)

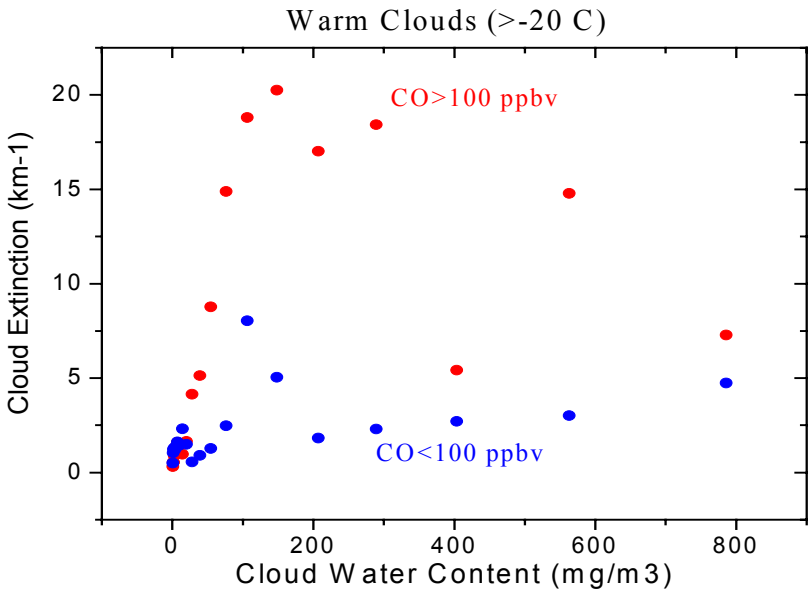


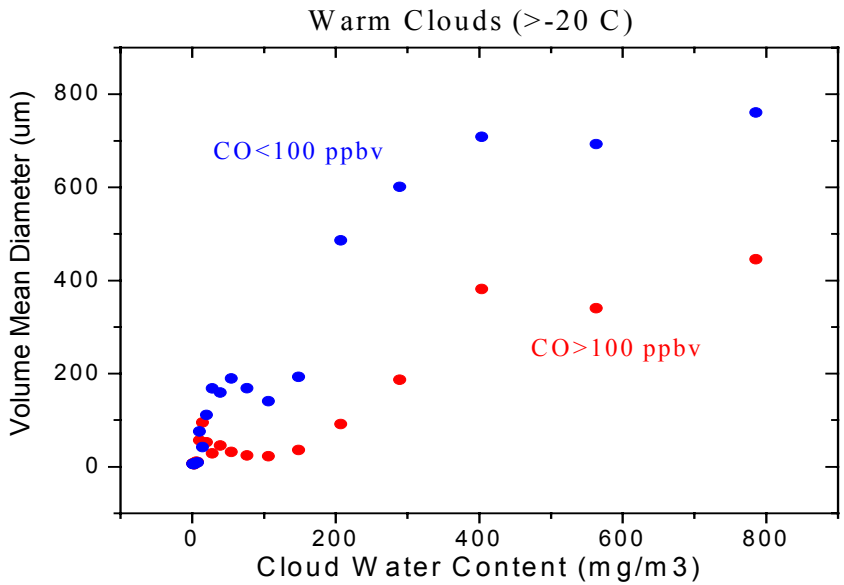


ARGE Influence of enhanced pollution on Cold and Warm Cloud Extinction and Volume Mean Diameter

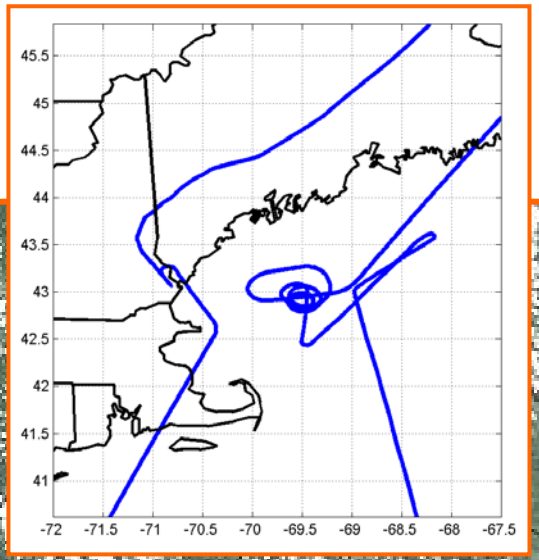


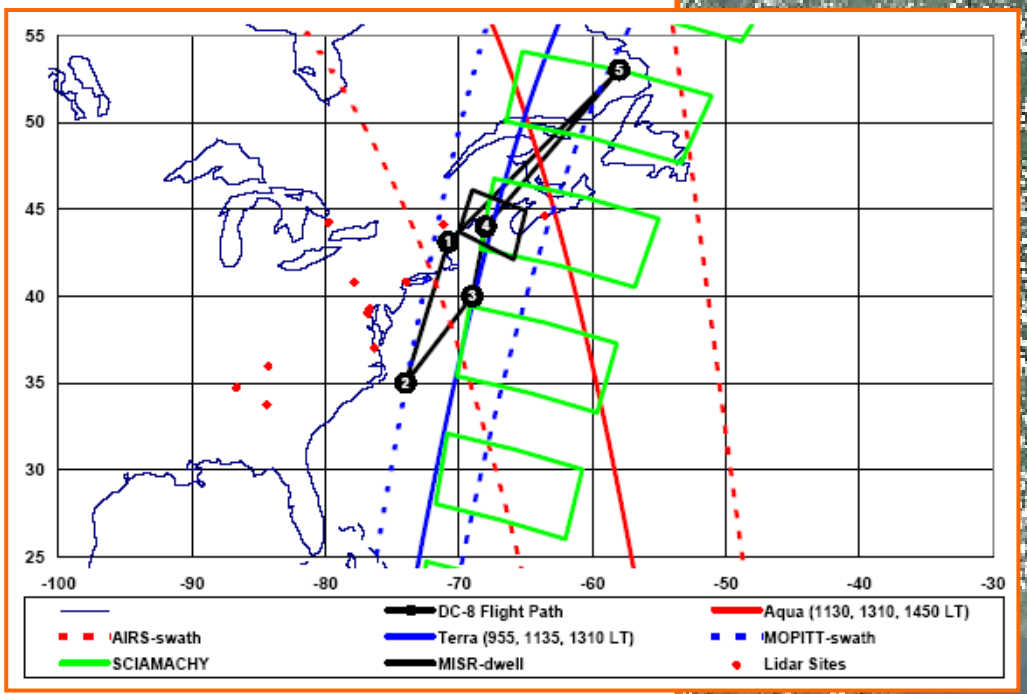






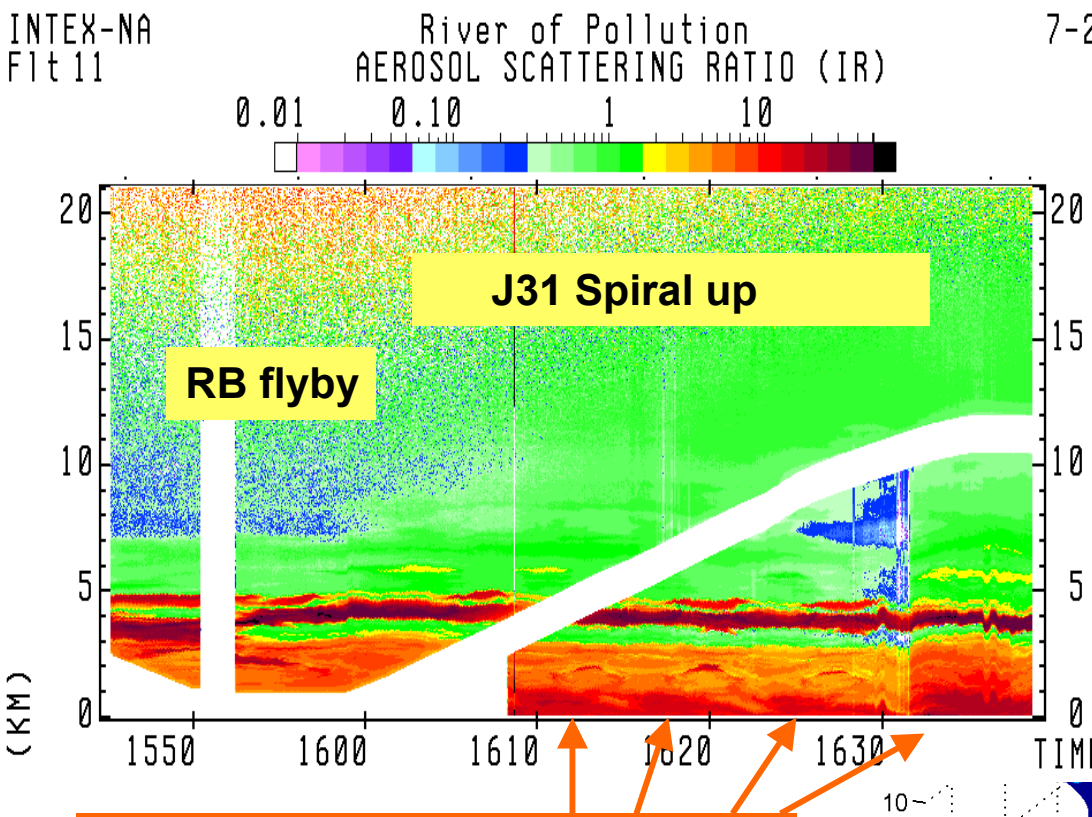
INTEX flight#11
Pease local 3 on 7/22
MISR/J31/DC-8
Satellite Closure Profile
Pollution and Biomass





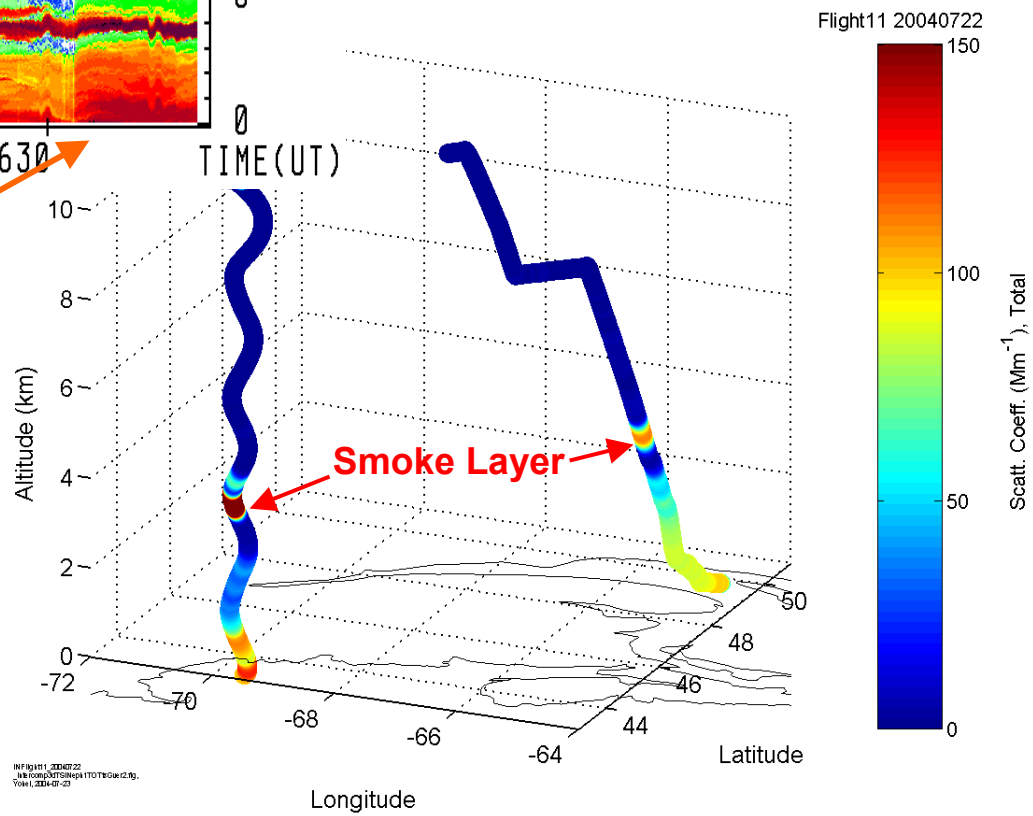
J31, RB

MODIS Image, 07/22/04



DC-8 DIAL Lidar puts in-situ data in context, Browell Group

3-D Structure repeated over circles



DC-8 Light Scattering on Spiral with J31 over RB and near Gaspe Peninsula

OE Area Distributions

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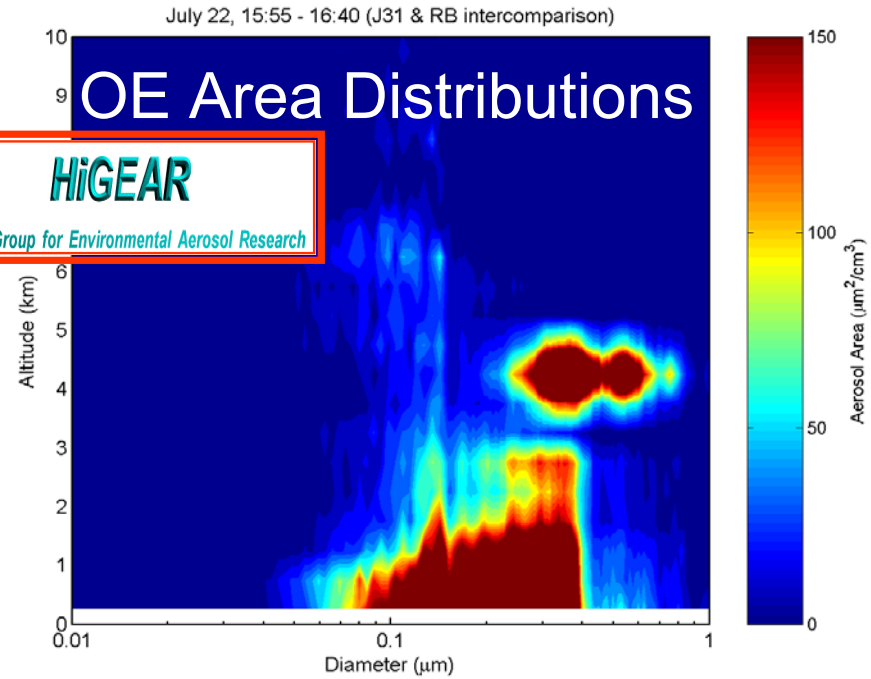
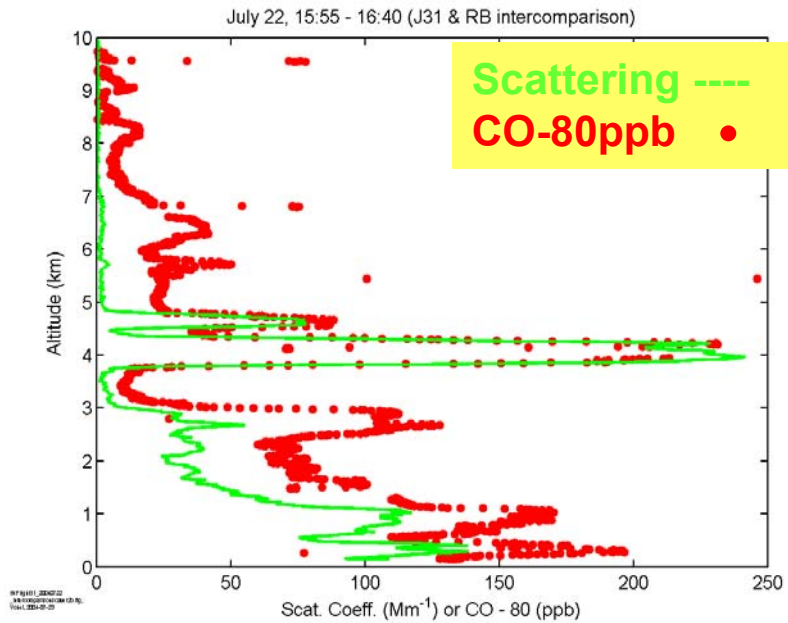


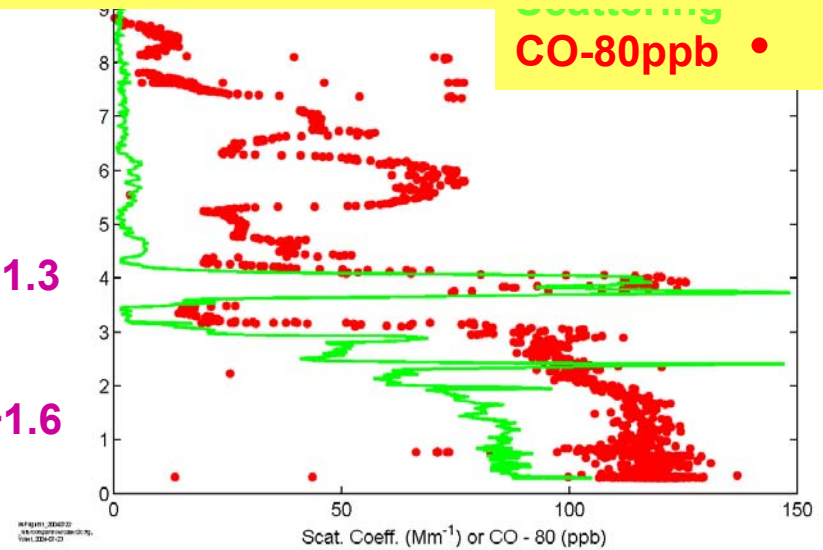
The combination of 3-D vertically resolved size and chemistry, f(RH), optics, ambient AOD (J31), lidar and satellite data allow coupling of various aerosol sources to spectral radiances and model emissions.

Integration of results should lead to improved global assessments of aerosol impacts.



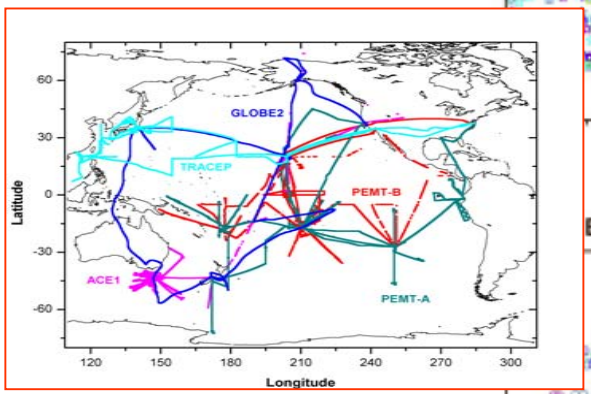
f(RH)~1.3

f(RH)~1.6

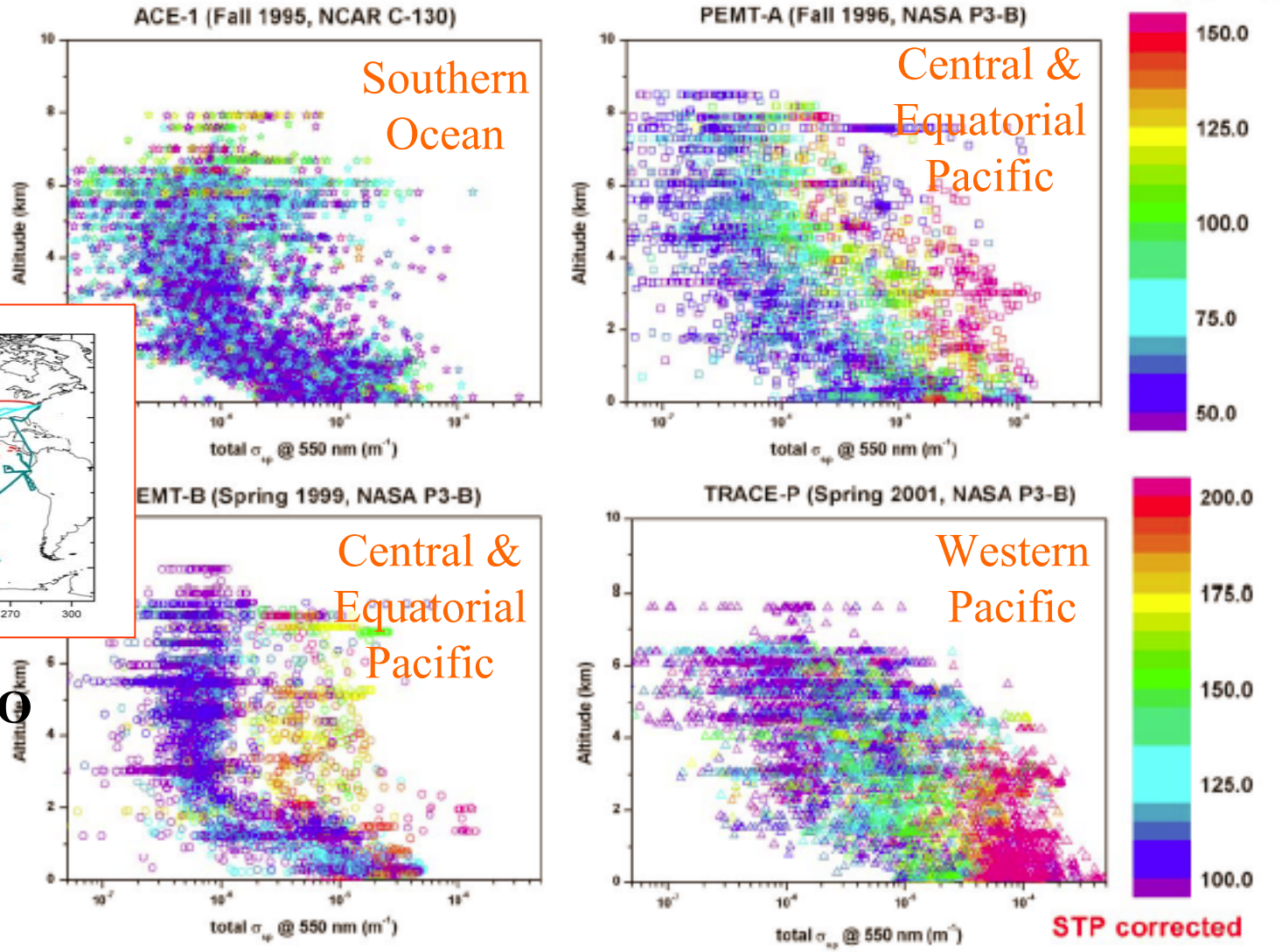


All Experiments

About 10 years and 600 profiles of scattering over Pacific.



Color coded by CO as a combustion indicator that tracks with BC



Global measurements of highest light scattering aloft (detected in satellite radiances) are associated with elevated CO and combustion aerosol superimposed on clean cloud-scavenged background.