G-1 Summary

Objectives and Approach

Intercomparisons

Some Results

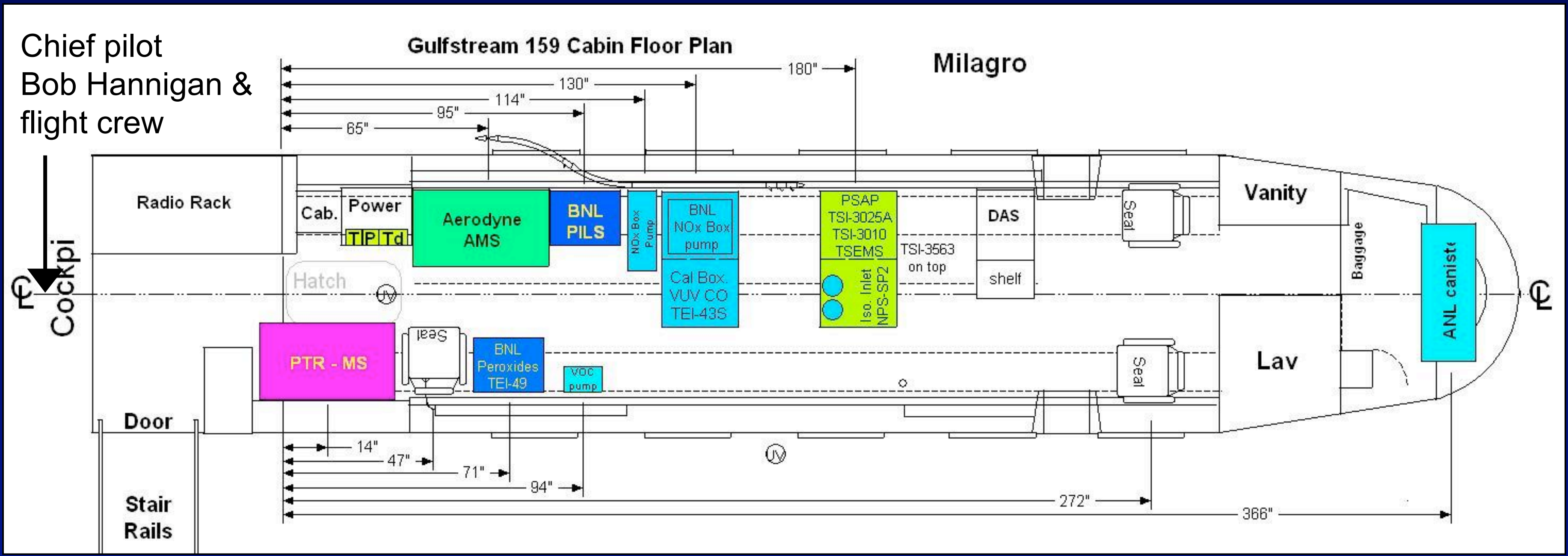
- Photochemical age
- SOA formation
- Aerosol optical properties
- Aerosol nitrate
- O_3 production rates

"I will not corners" Bart Simpson

Data presented here is preliminary.
Science is 1 to 4 weeks old.

fttp://ftp.asd.bnl.gov/pub/ASP Field Programs/

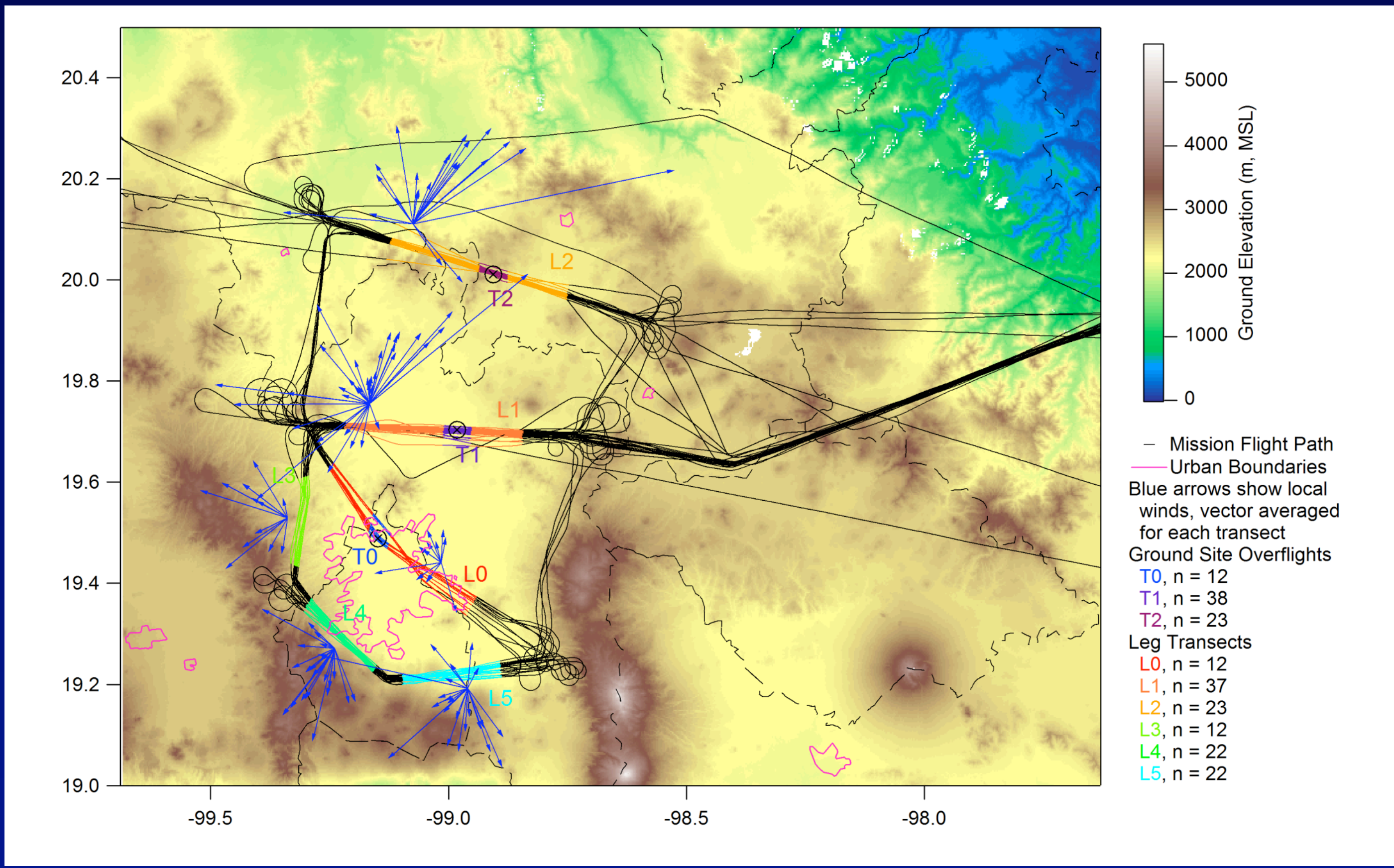
ASP G-1 Research Aircraft Facility Layout



PCASP, CAPS – PNNL, BNL: Senum, Hubbe
State – PNNL: Hubbe
PTRMS - EMSL: Alexander, Ortega
AMS - Aerodyne, EMSL: Alexander, Jayne
Peroxides - SUNY, BNL: Lloyd, Bowerman
VOCs – York: Hubbe, Rudolf
PILS – BNL: Lee

CO, NO, NO_2, NO_y O_3, SO_2 – BNL: Springston, Senum
PSAP, Neph, CNCs – PNNL: Group
TSEMs – BNL: Wang
MFRs – PNNL: Barnard
SPSP – DMT, CIRPAS: Kok, Jonsson, Senum
Balloons – PNNL: Zaveri, Hubbe
Data – PNNL, BNL: Hubbe, Springston, Senum

Flight Plans and Winds



Winds at T1 and T2 from SSW

Upslope winds along basin rim

OBJECTIVES

Characterize Source Region

Time Evolution of Aerosols in the Near-Field (0 to 12 hours)

- Chemical composition
- Size distribution
- Optical properties

Photochemistry

- O_3 productions rates and NO_x/VOC sensitivity
- SOA precursors

Chemical Signatures to Diagnose Boundary Layer Flows

- Coordinate with King Air Lidar measurements

Approach

Repetitive flight plans with 10's of transects over T0, T1, and T2
Assemble statistics by location and for all plumes

Kinetics from Lagrangian Expt. when flow is from T0 to T1 to T2

More generally, use photochemical age and location to provide time scale
Use CO as an inert tracer of urban emissions

Transects at multiple altitudes for determining basin flows

Compare Mexico City with U.S. urban areas

Box model calculations for $P(O_3)$ and NO_X/VOC sensitivity

Need partners for analysis and calculations

IT WORKED!

Dirty Air is More Interesting than Clean Air

Most equipment worked most of the time
Good intercomparison and self consistency

T1 to T2 Lagrangian transport days with AM and PM flights

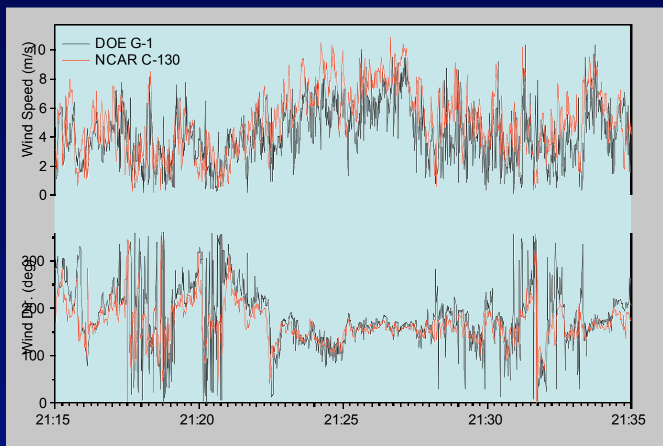
Age markers useful under less well defined transport conditions

Chemical mixtures different than observed in U.S. urban areas
More of the same or new processes?

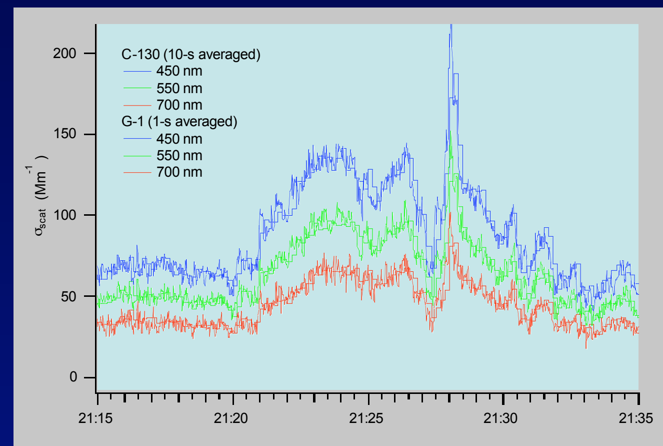
Missing: PM flights in urban basin in 2nd half of program

Intercomparisons

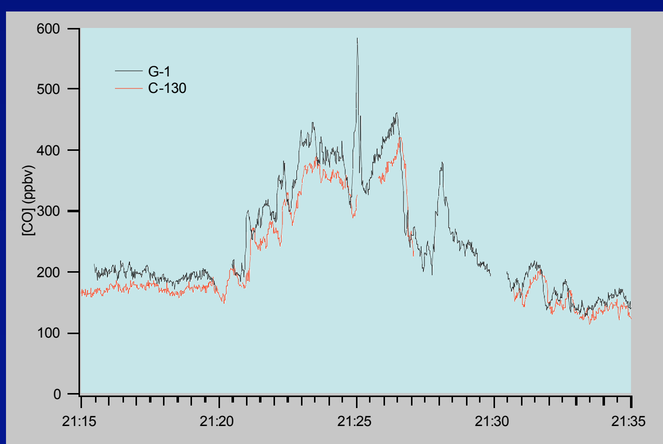
Winds: G-1, C130



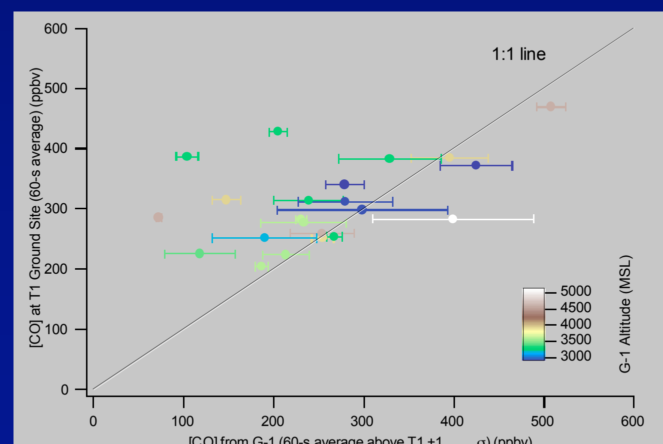
Scattering: G-1, C-130



CO: G-1, C130



CO: G-1, T0

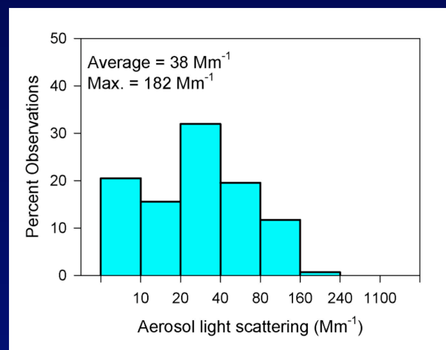


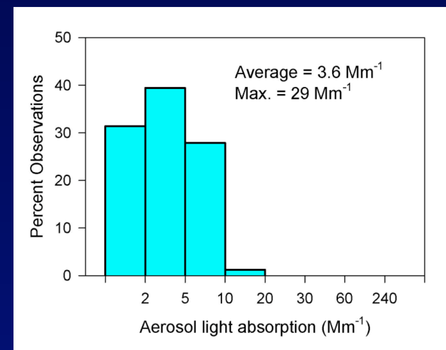
Stephen Springston G-1, Gao Chen C-130, Greg Huey T0

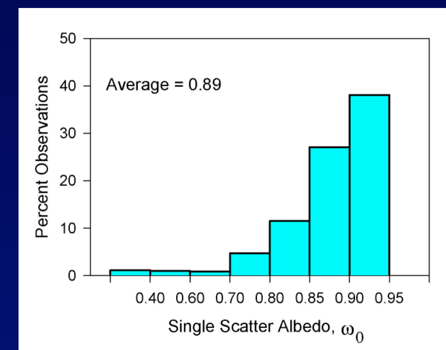
Aerosol Optical Properties

Scattering | Absorption | Single Scatter Albedo

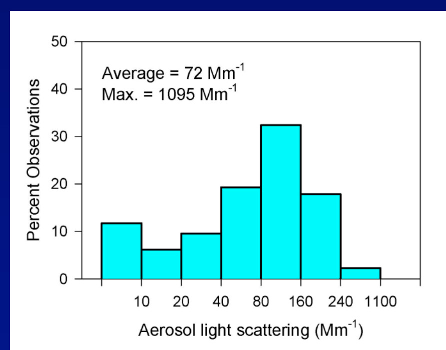
Eastern U.S. (2002, NEAQS)

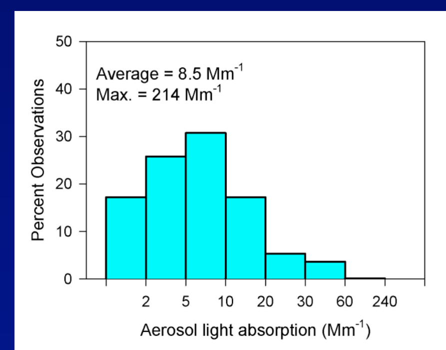


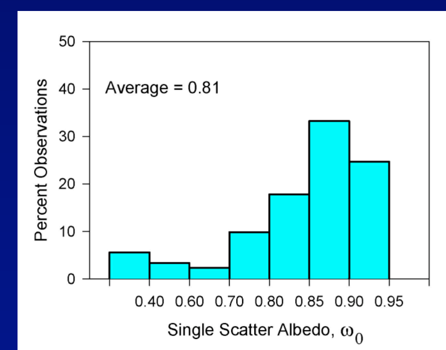




Mexico City Basin



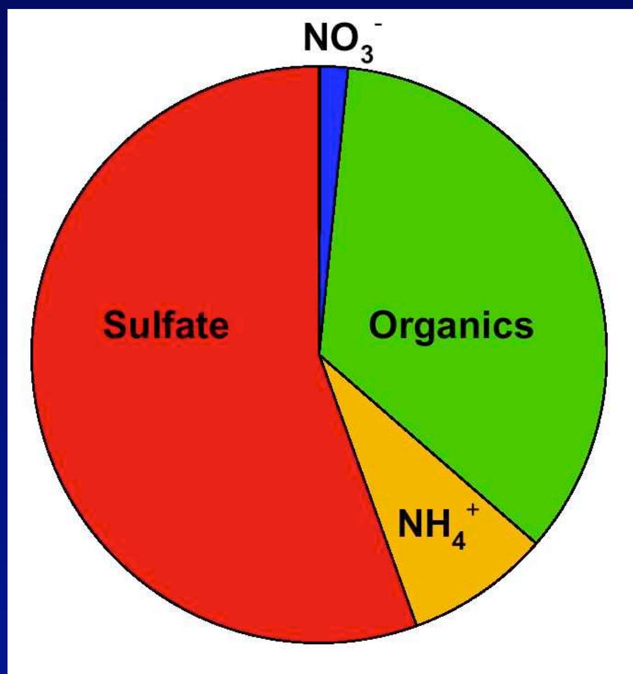




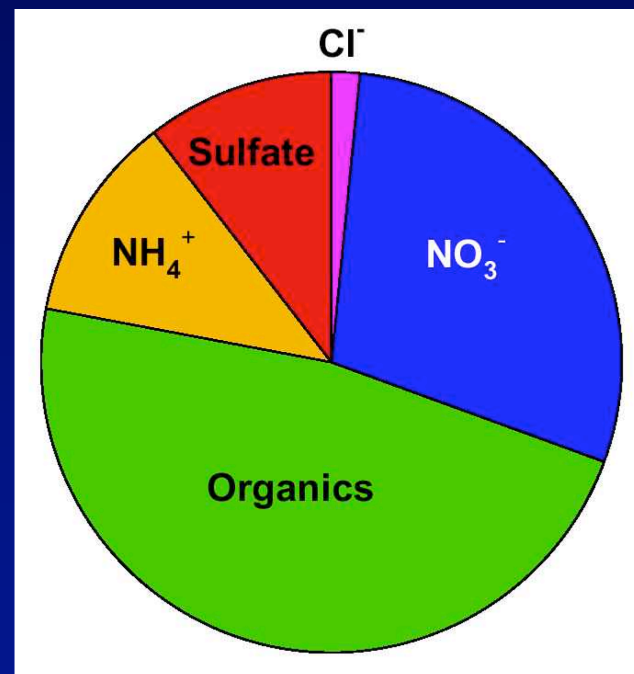
- Light scattering, absorption were 2 times Eastern U.S.
- Urban area routinely surpassed peak U.S. values
- Higher proportion black carbon in Mexico aerosol
- Mexico aerosol has lower ω_0 than U.S.

Aerosol Composition Comparison

Eastern U.S. Regional Pollution



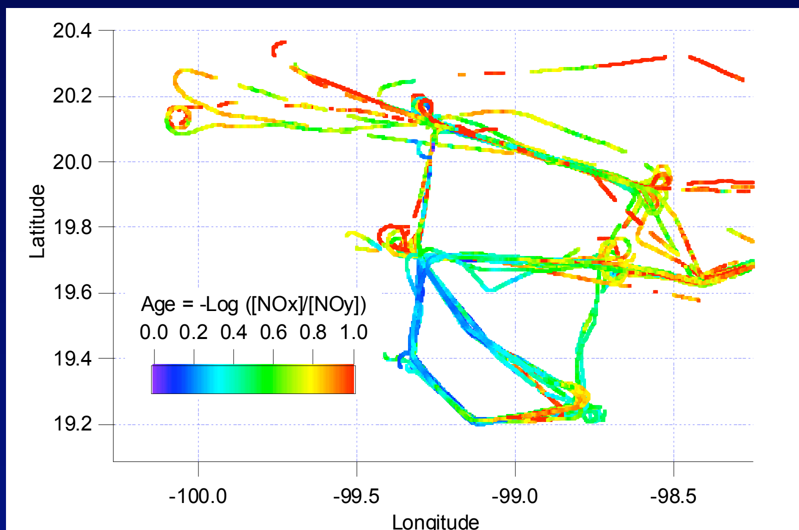
Mexico City Urban

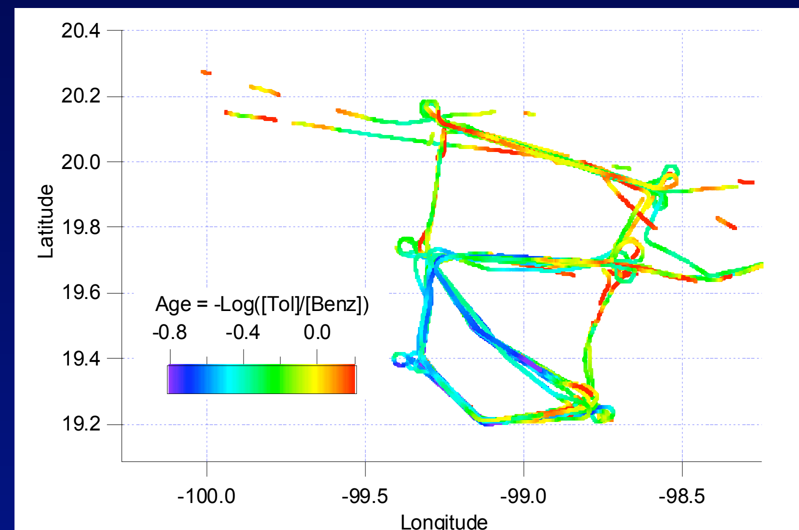


- Eastern U.S. episodes - sulfate dominated
- Mexico urban aerosol - organic dominated, with nitrate

Photochemical Age

NO_x/NO_y | Toluene/Benzene





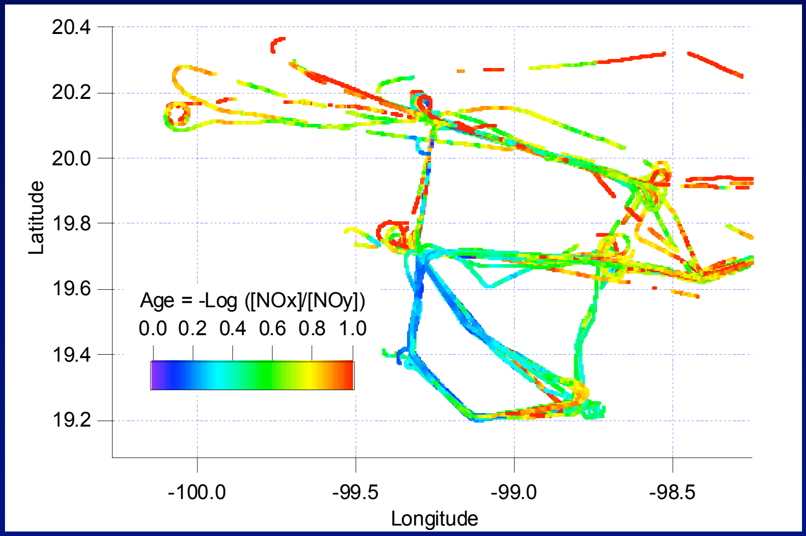
NO_x/NO_y and Toluene/Benzene decrease with photochemical processing - at about the same rate. Graphs cover factor of 10 change.

Fresh emissions (High ratio – low age) over T0 and West and SW Basin

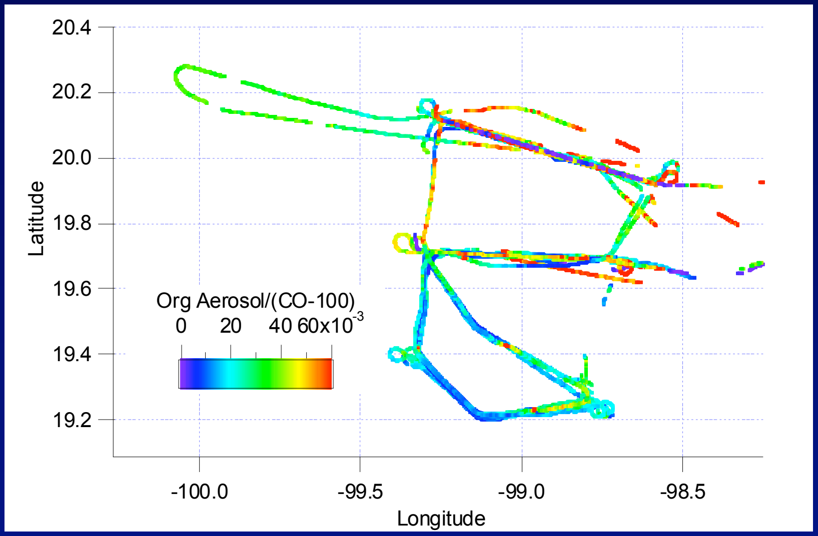
Air masses are older to North and East

SOA and Photochemical Age

Age = - Log([NO_x]/[NO_y])



[Organic Aerosol]/([CO] – 100 ppb)



Assume CO is an inert tracer of POA and SOA precursors

Without SOA production [Organic]/[CO] is constant

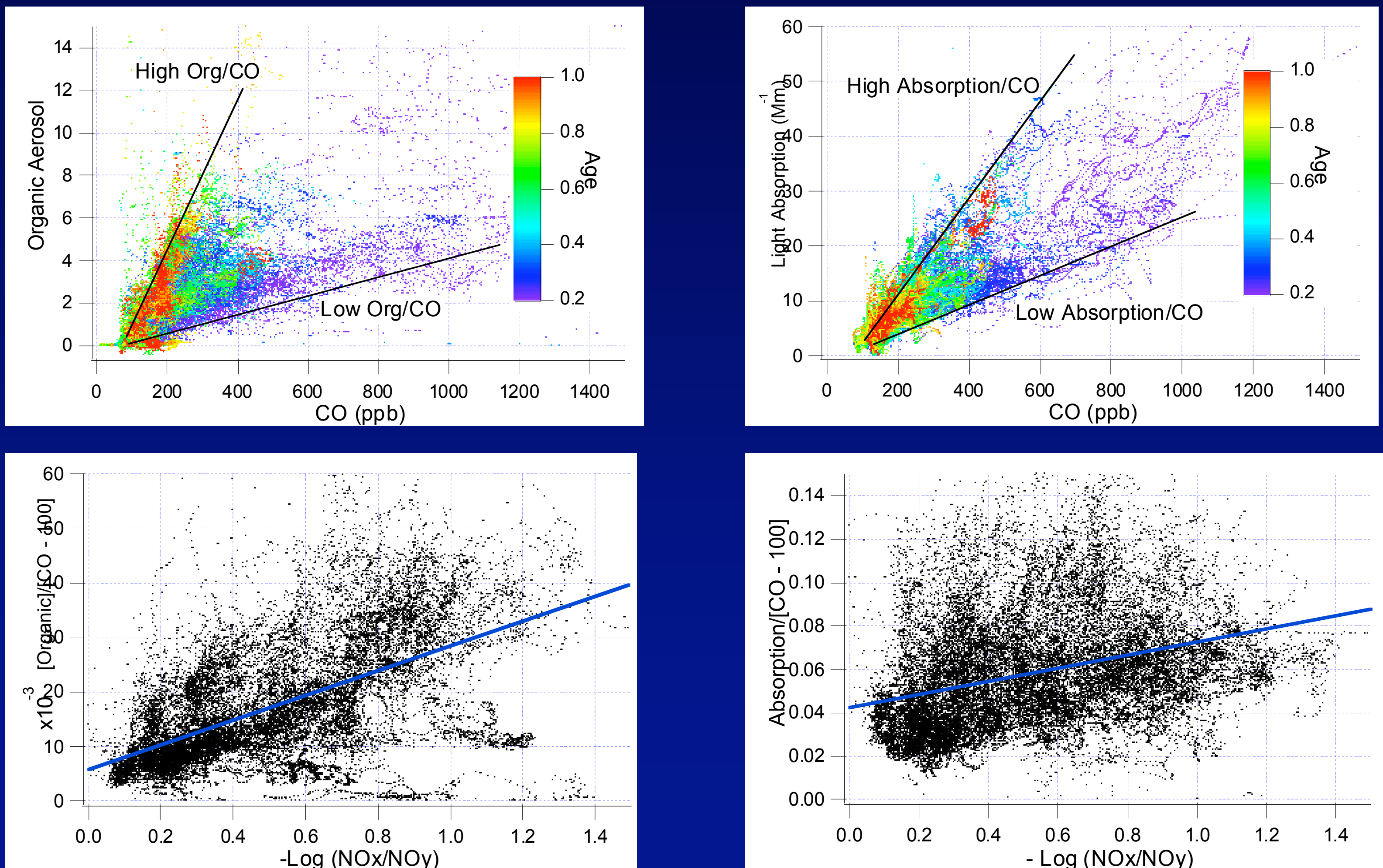
Lowest [Organic]/[CO] ratio occurs in low age air masses over T0 and to W and SW

To the North and East, air masses are older and [Organic]/[CO] ratio increases 8-fold

Time Evolution of SOA and Light Absorption

Organic aerosol/CO

Light Absorption/CO

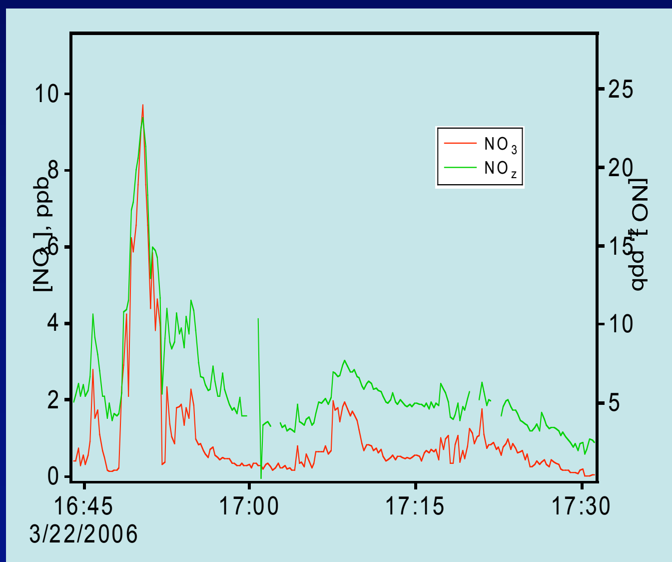


8 – fold increase in Organic with age

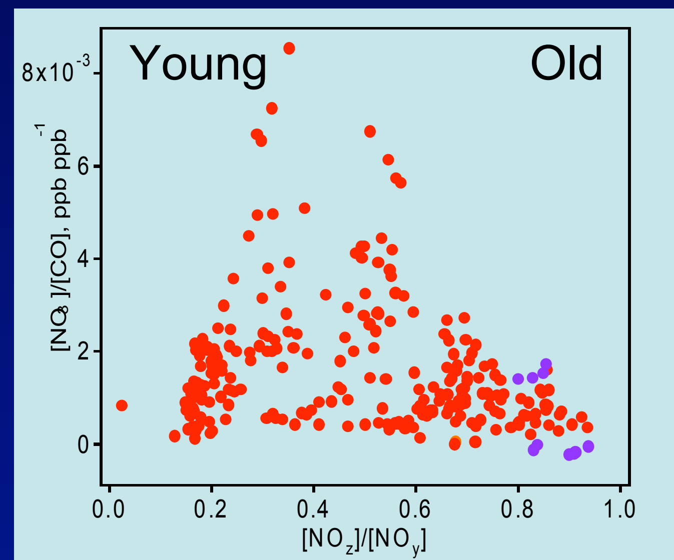
2-fold increase in Light Absorption with Age

Aerosol Nitrate

Aerosol NO_3^- and NO_z vs time



$[NO_3^-]/[CO]$ vs. $[NO_z]/[NO_y]$



Gas-Aerosol partitioning of NO_3^- can be followed on 10 s time scale

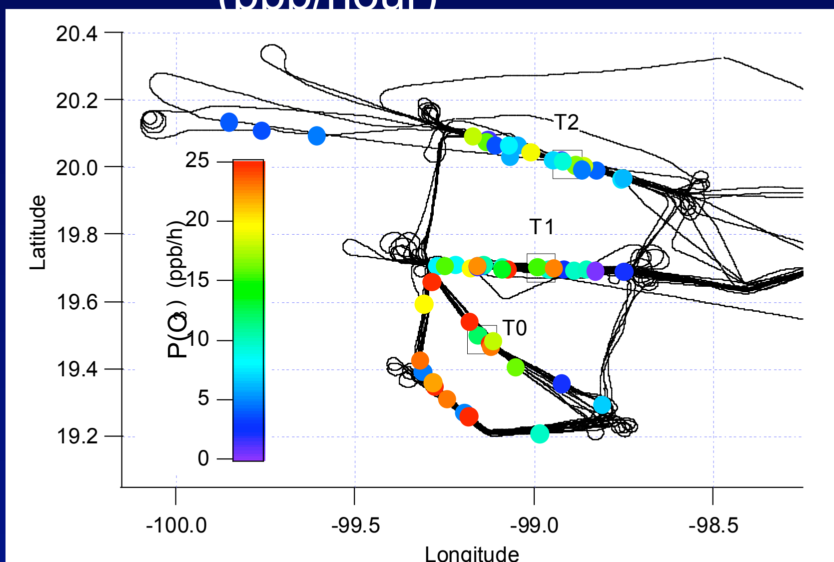
Near emission source NO_3^-/CO increases from photochemistry

Away from source NO_3^- evaporates

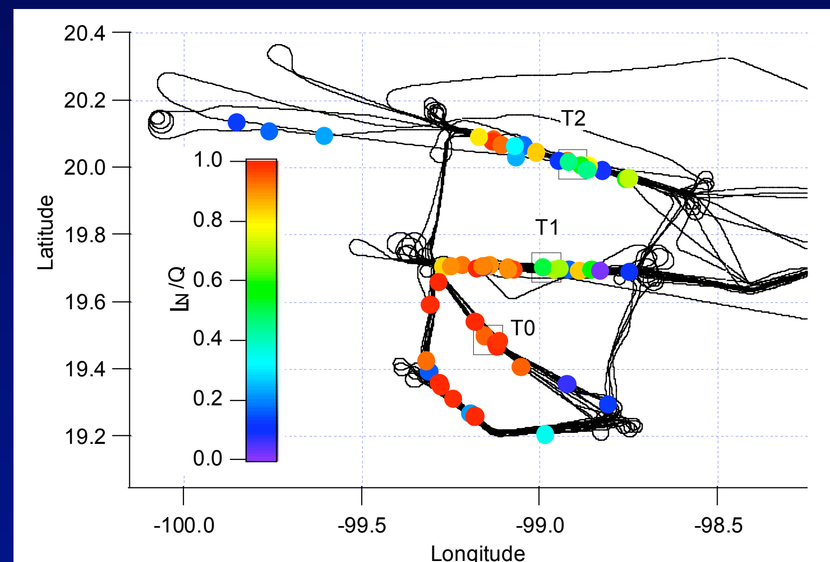
Ozone Production

Constrained Steady State Box Model Calculations

$P(O_3)$ (ppb/hour)



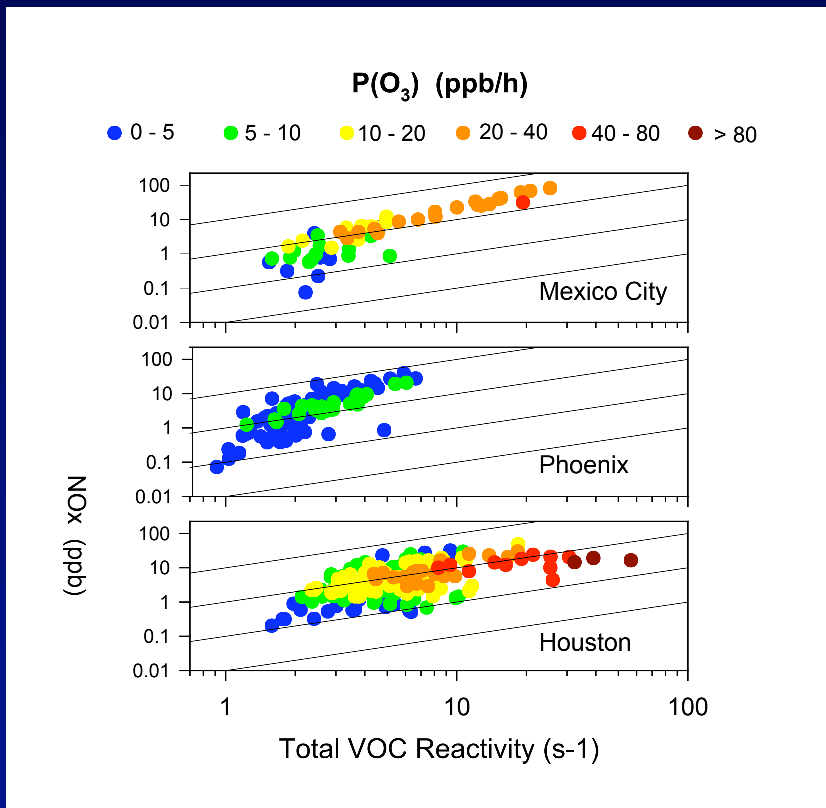
L_N/Q; 0 = NO_x limited, 1 = VOC limited

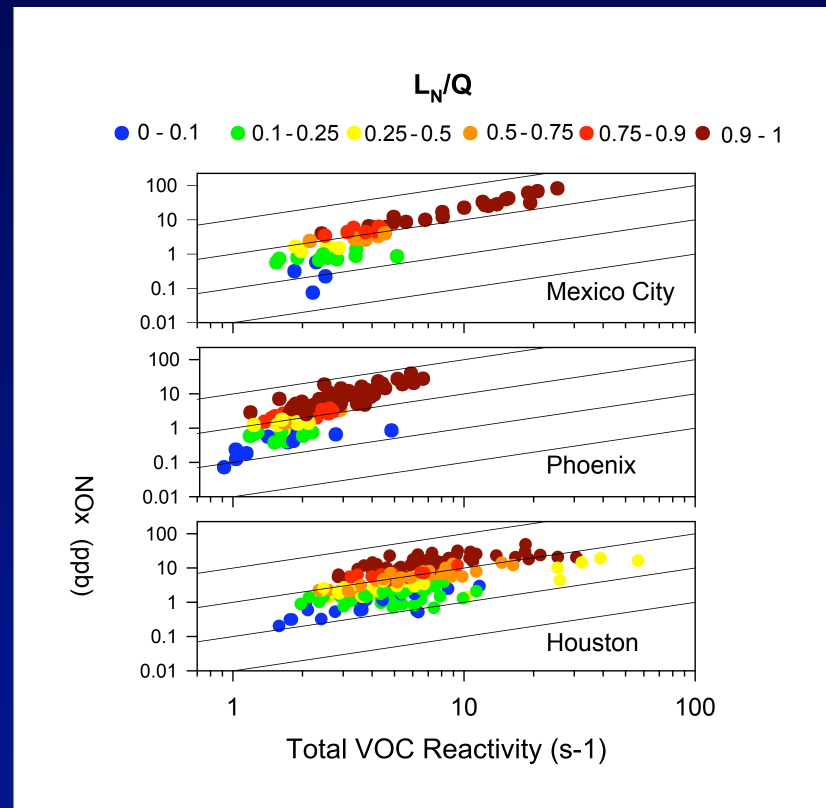


Peak $P(O_3) \approx 30$ ppb h^{-1} over City and to W and SW

Peak $P(O_3)$ occurs under VOC limited conditions

Mexico City, Phoenix, and Houston





For VOC limited conditions: $P(O_3) \approx (VOC/NO_2)_{reactivity}$ H Q(radical production rate)

Extreme $P(O_3)$ as in Houston requires a higher VOC/NO_x ratio

Posters

Overview and Intercomparisons: Stephen Springston

Aerosol Composition and Evolution: Yin-Nan Lee

Ozone Production and Aerosol Evolution: Larry Kleinman

Peroxides: Judy Weinstein-Lloyd

PTRMS: John Ortega

WRF Chem – Aerosols: Jerome Fast

T1 – T2 Overview: Chris Doran

KA Lidar: John Hair