

# CARES Data Workshop

Atmospheric System Research Program  
Science Team Meeting, March 27, 2011  
San Antonio, TX



# CARES Objectives and Goal

## Science Objectives:

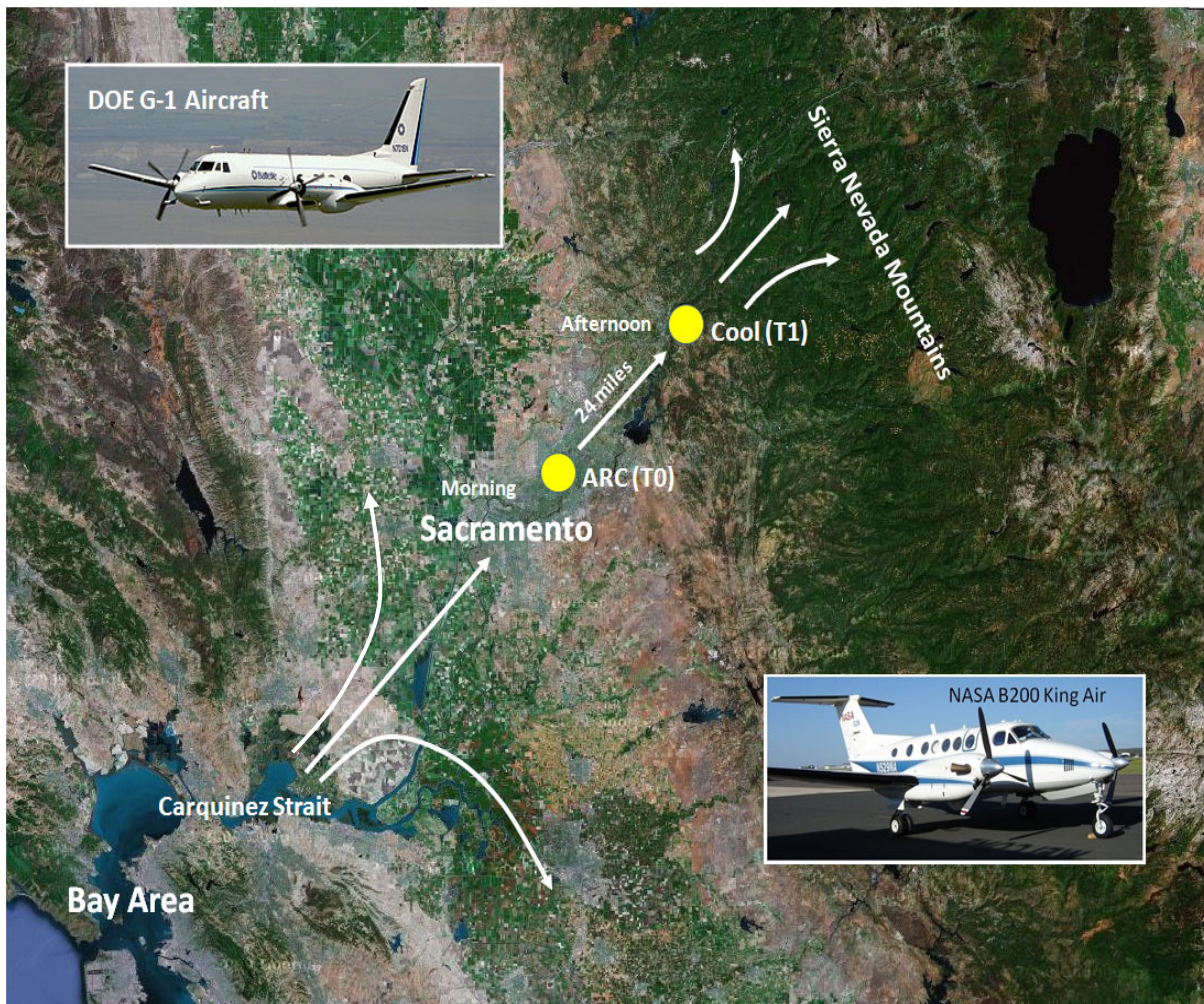
- ▶ Investigate secondary organic aerosol (SOA) formation from anthropogenic and biogenic precursors and the potential interactions between them.
- ▶ Characterize the time scales of black carbon (BC) ageing and quantify the relative contributions of condensation and coagulation to BC mixing state evolution.
- ▶ Quantify the effect of aerosol mixing state and the role of organics on the associated optical and CCN activation properties. Perform local closure studies.
- ▶ Quantify the contribution of new particle formation and growth to CCN population.

## Overarching Goal:

Evaluate and improve aerosol modules for the above mentioned processes and properties for use in regional, global climate models

# Sampling Strategy and Platforms

Sacramento, June 2-28, 2010



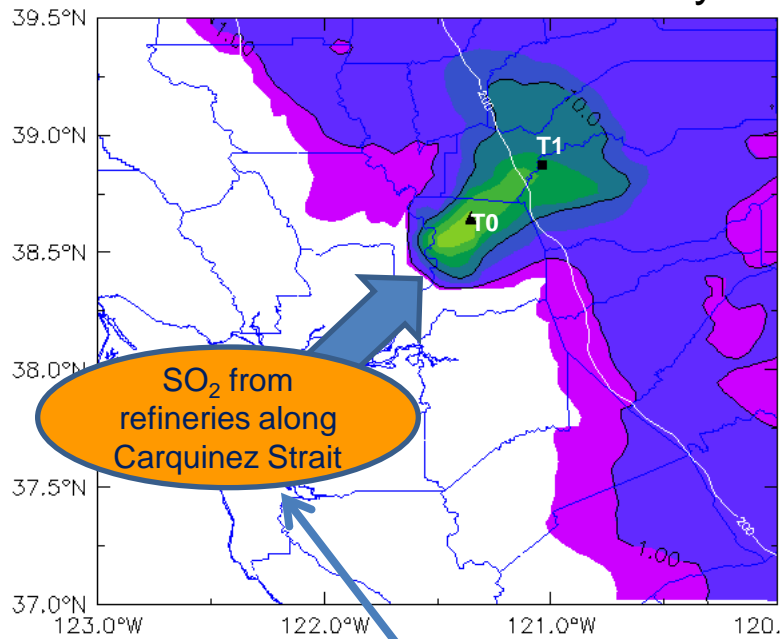
## Rationale

- Mid-size City
- Fairly isolated and clean to the north
- Regular wind pattern
- Rich biogenic emissions

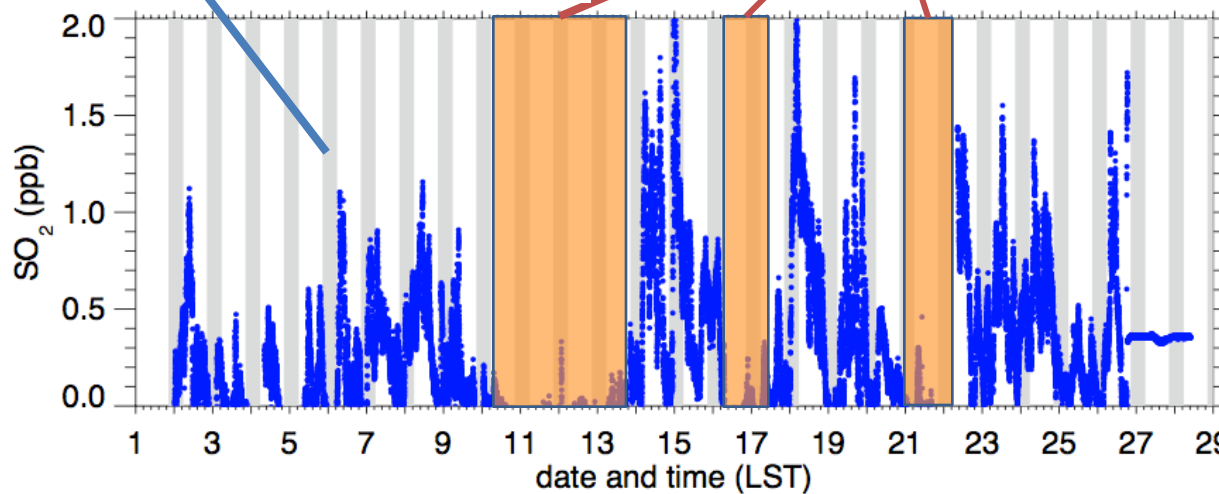
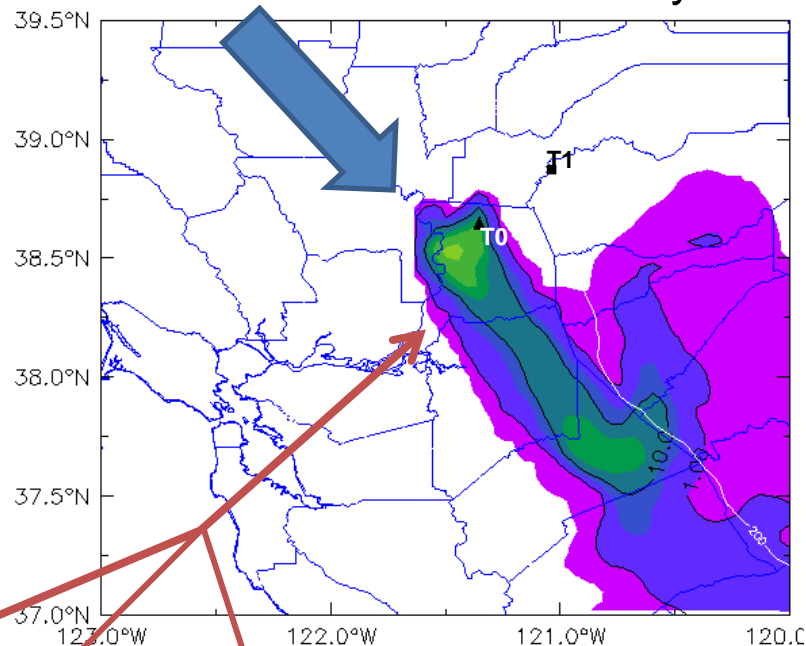
Sacramento plume serves as a meso-scale flow reactor

# Two Predominant Sacramento Plume Patterns Observed

## SW Flow ~15 out of 27 days

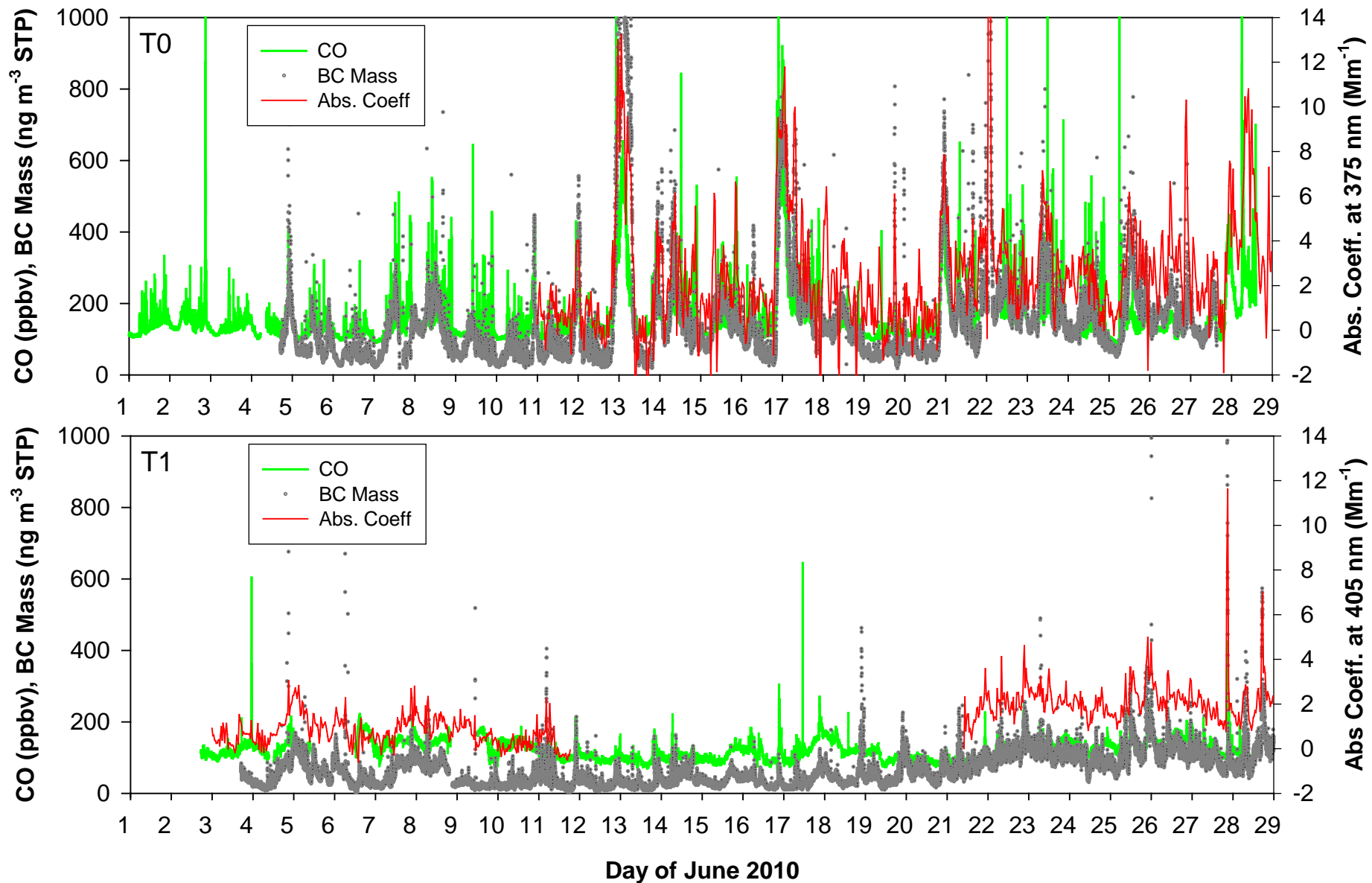


## NW Flow 9 out of 27 days

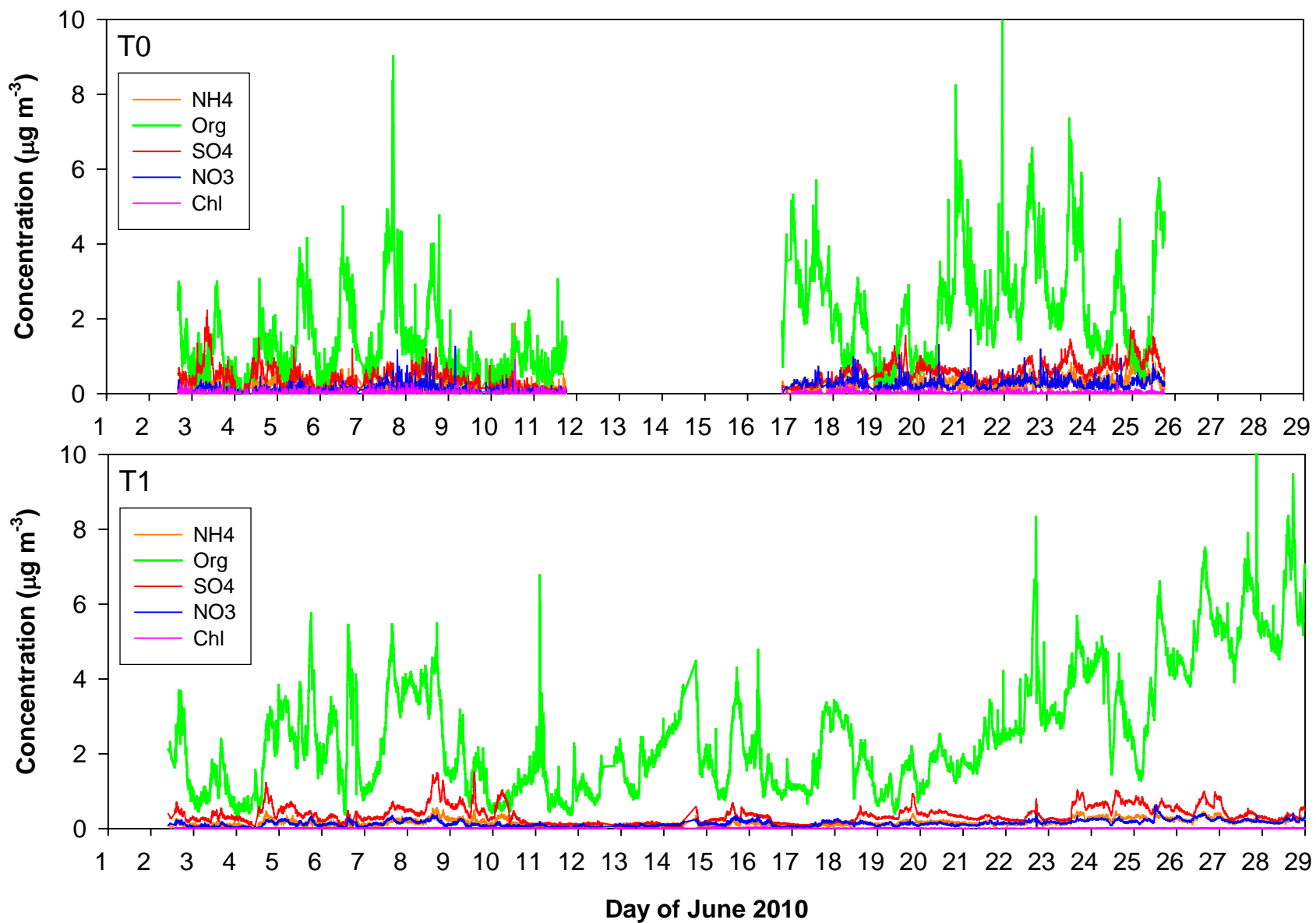




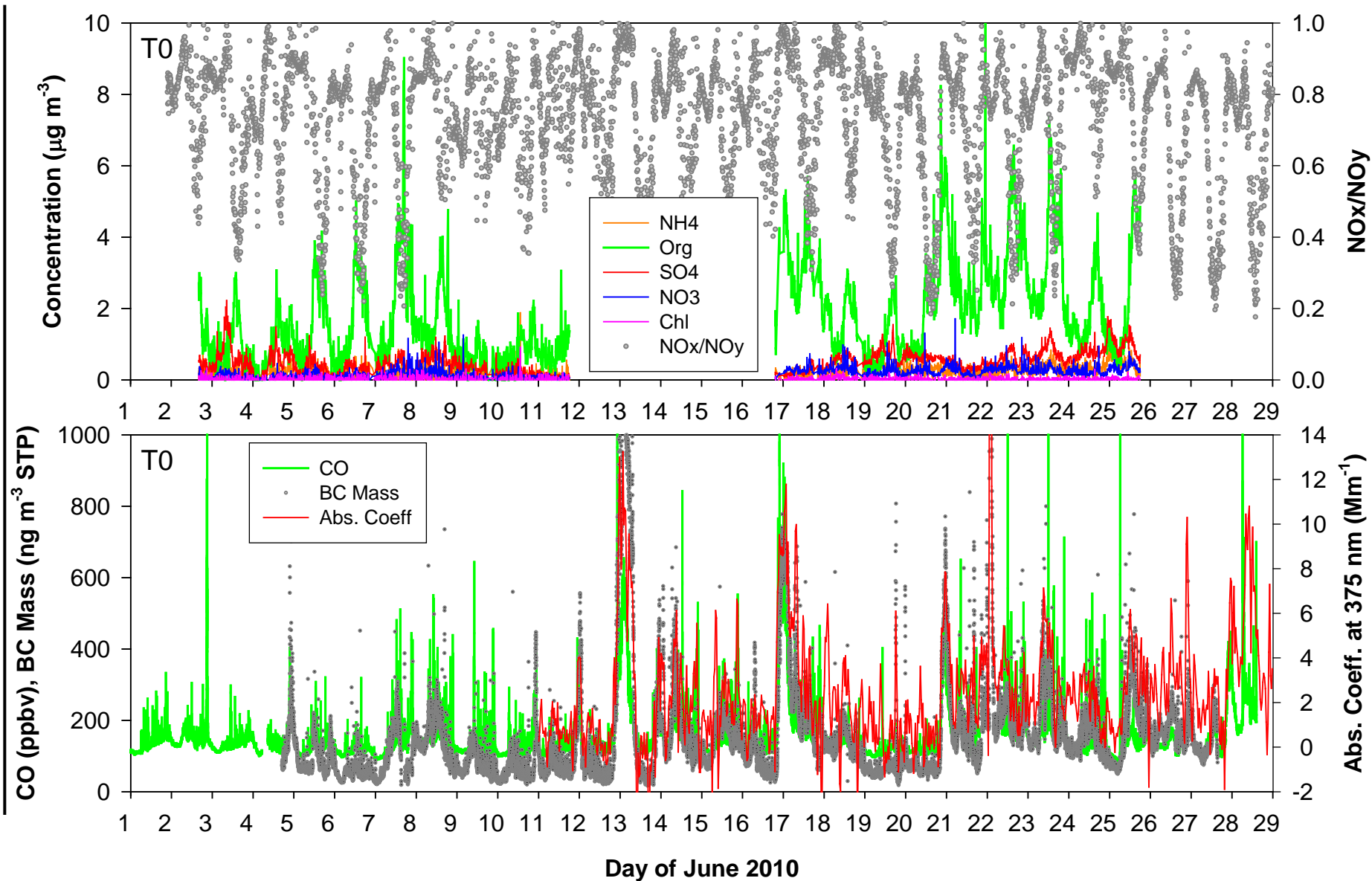
# CO, BC, and Absorption Coeff at T0 and T1



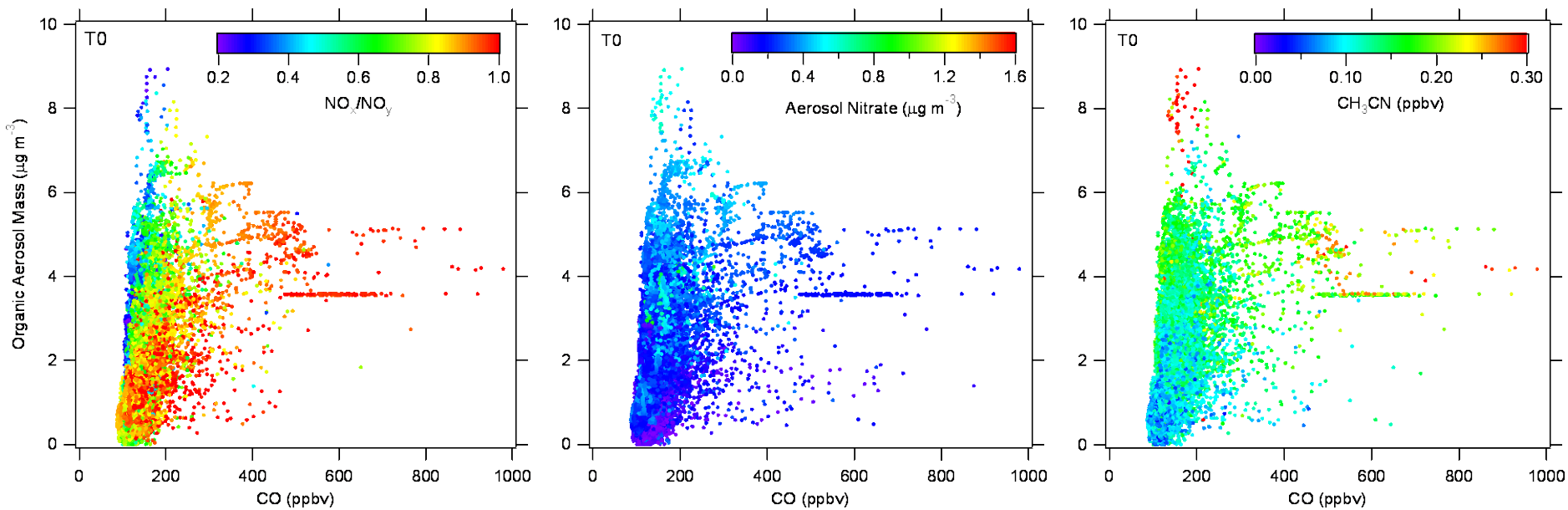
# AMS Aerosol Composition at T0 and T1



# Time Series at T0

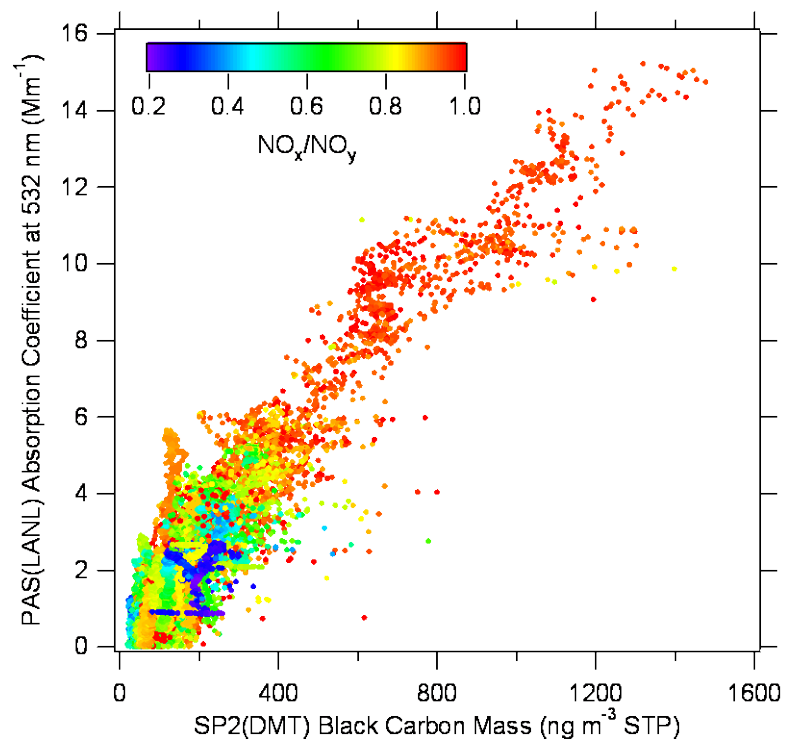


# Organic Aerosol at T0



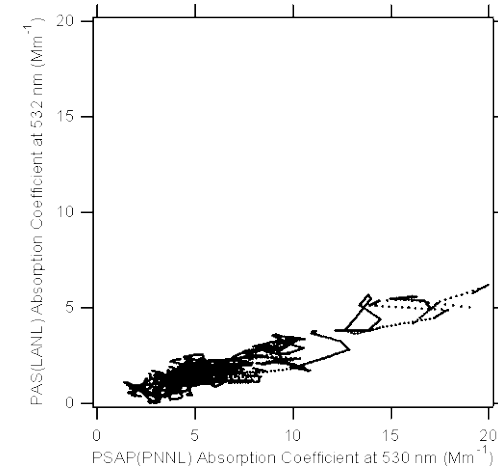
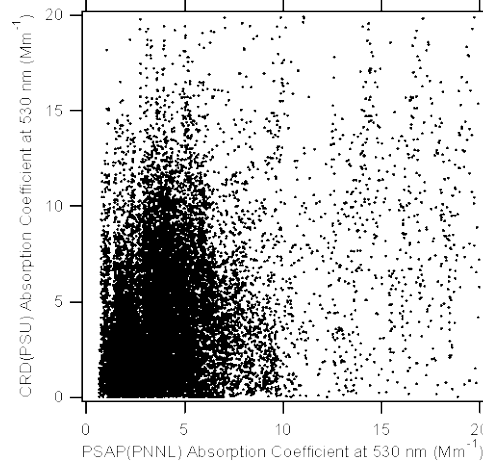
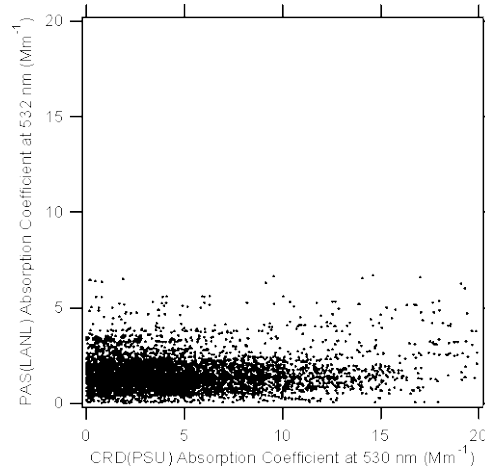
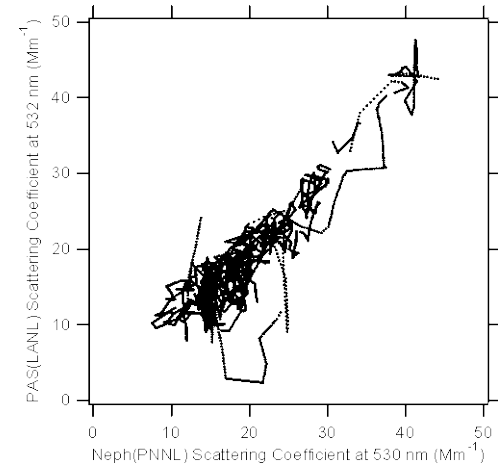
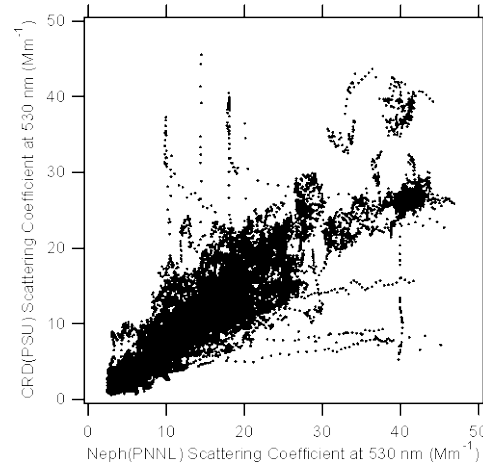
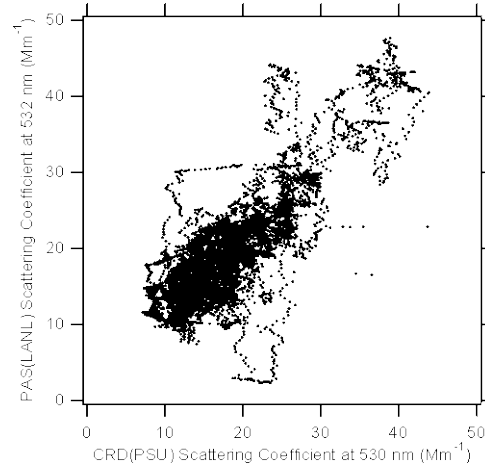


# BC Aging and Absorption at T0



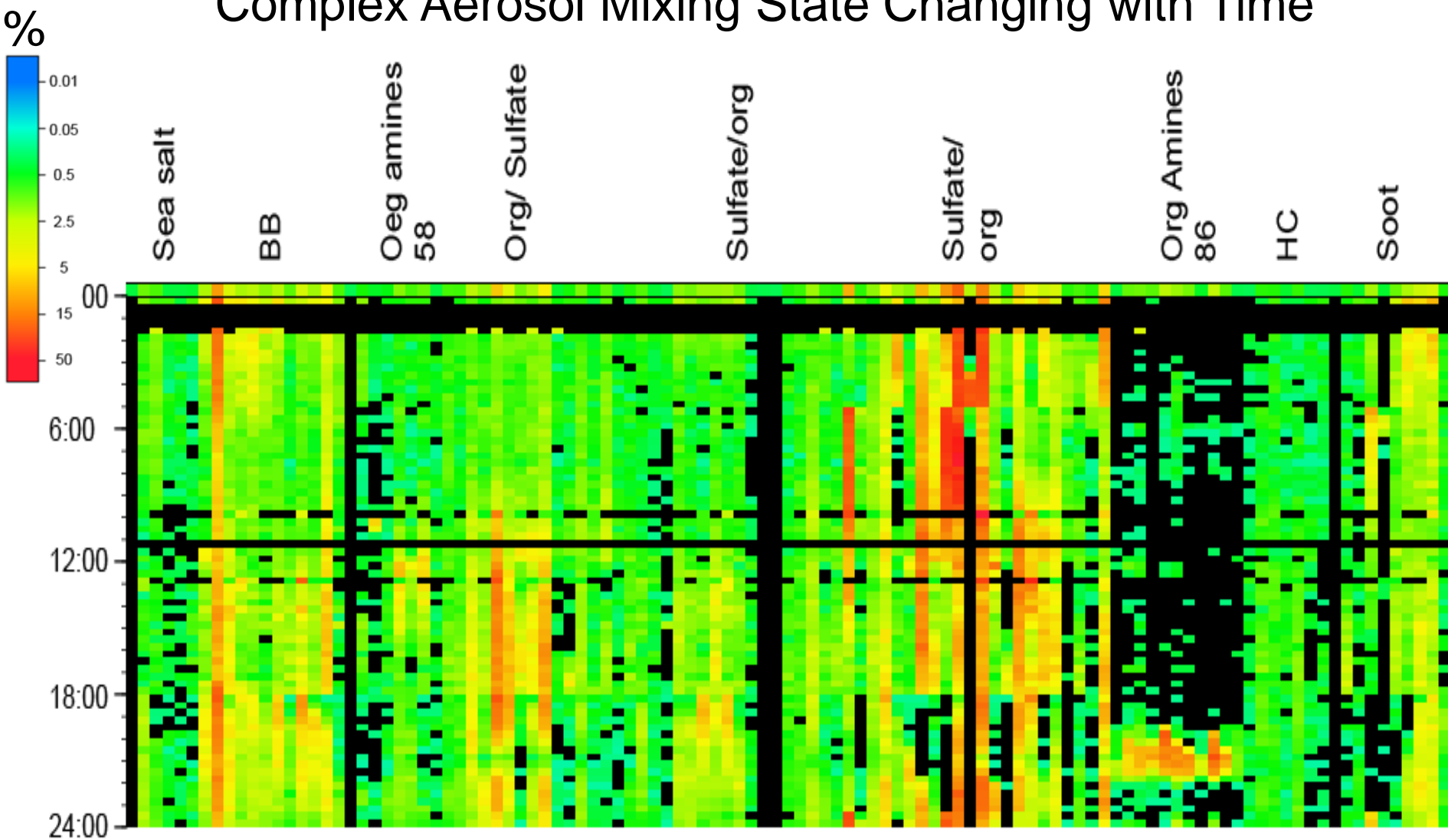
# Intercomparison of Optical Properties at T0

## 1-minute interpolated values



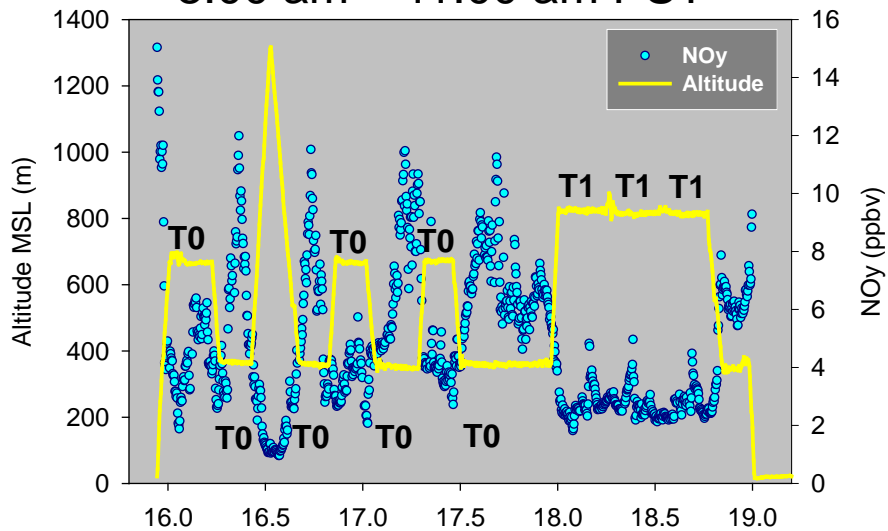
# SPLAT II: Single Particle Composition at T0

Complex Aerosol Mixing State Changing with Time

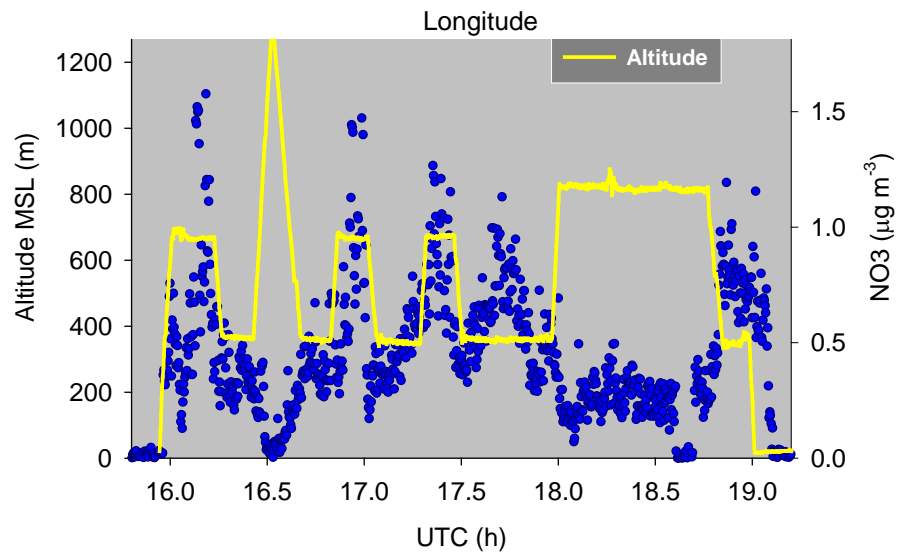
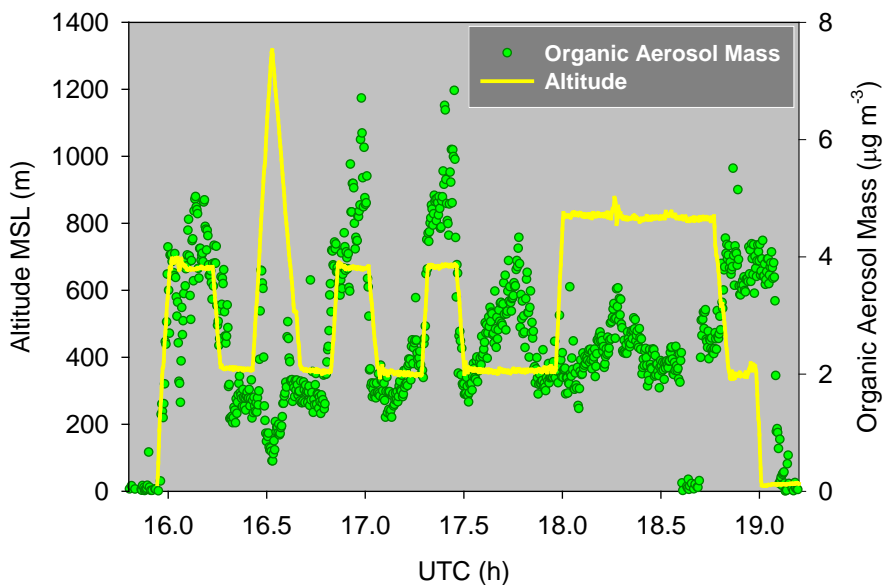
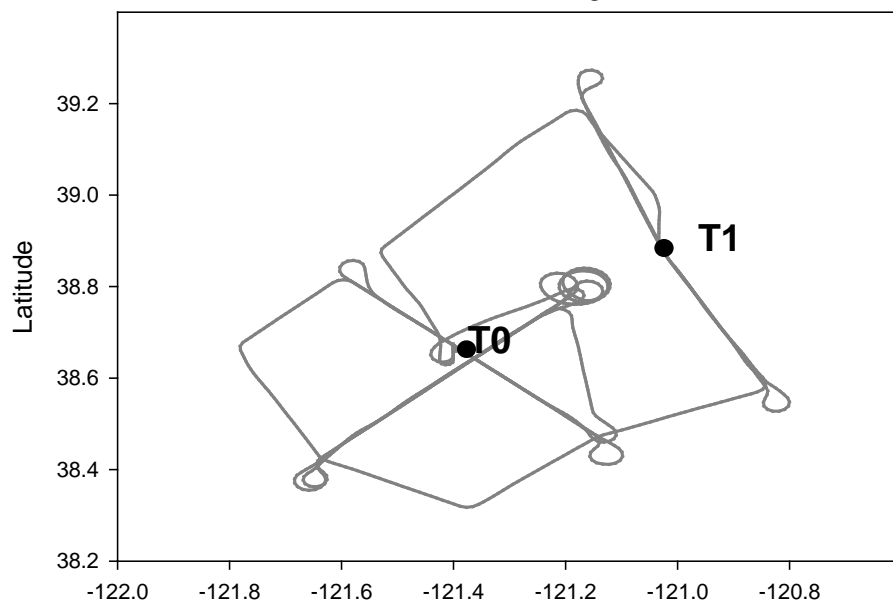


# Evidence for Aged Air Mass Recirculated from the Previous Day

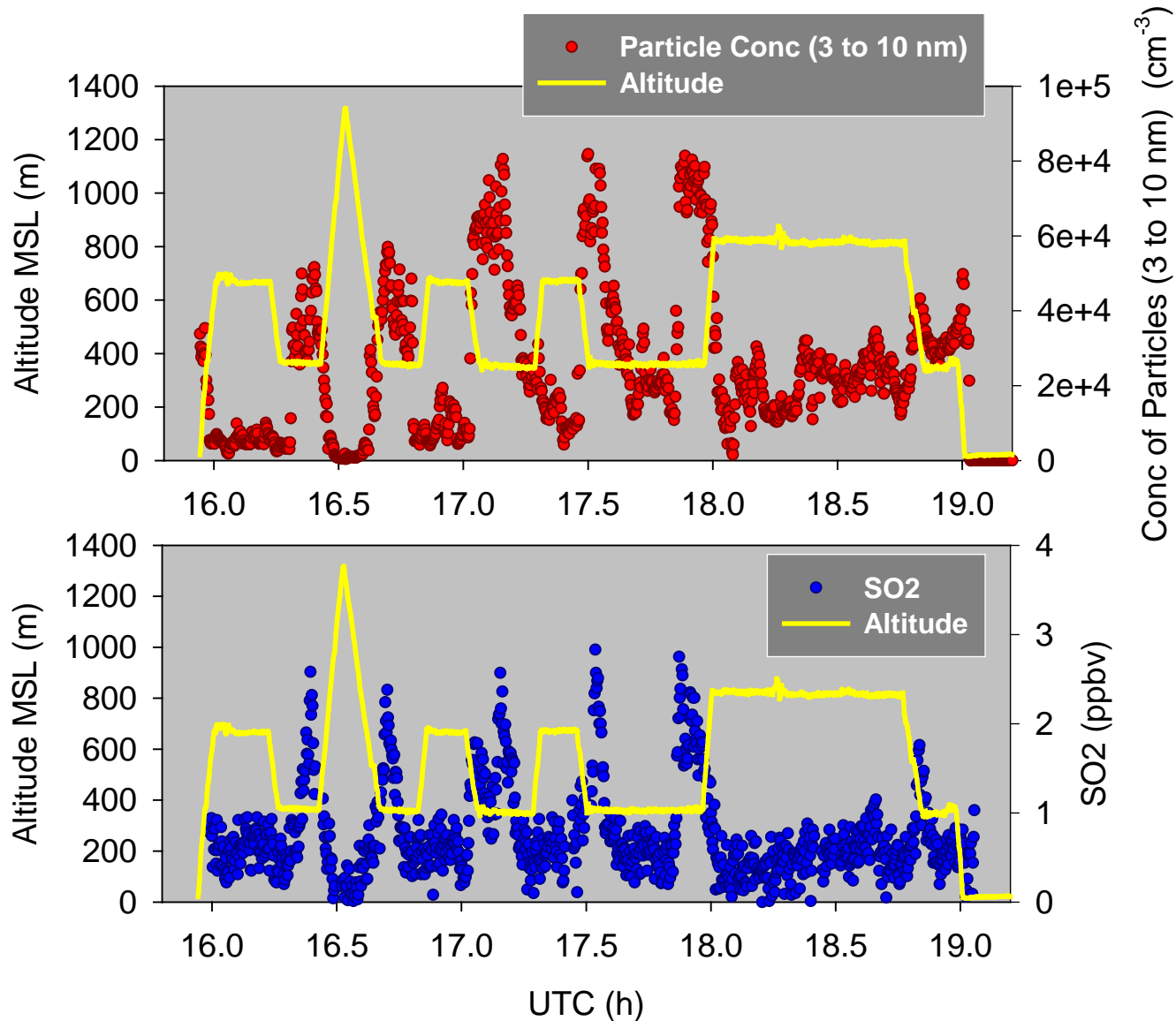
8:00 am – 11:00 am PST



June 15 AM Flight



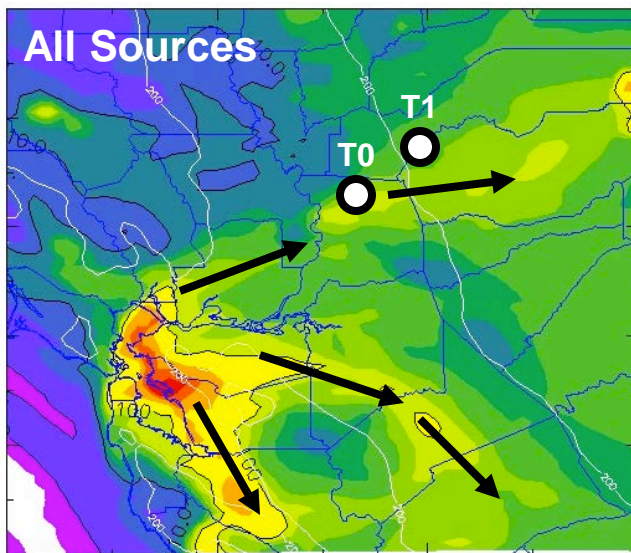
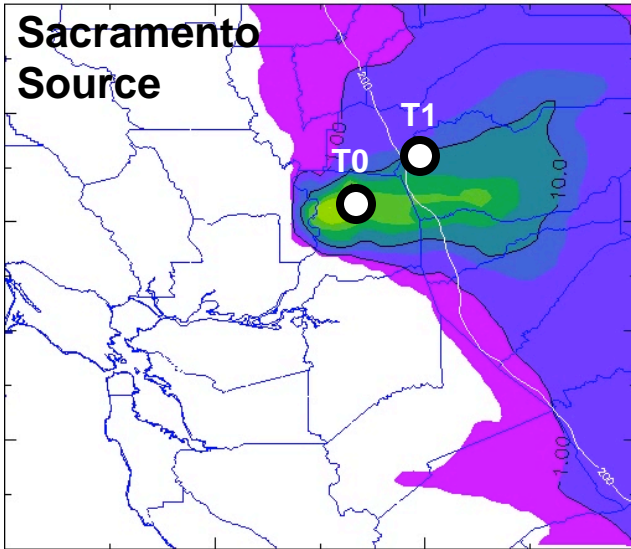
# Large Concentrations of Ultrafine Particles





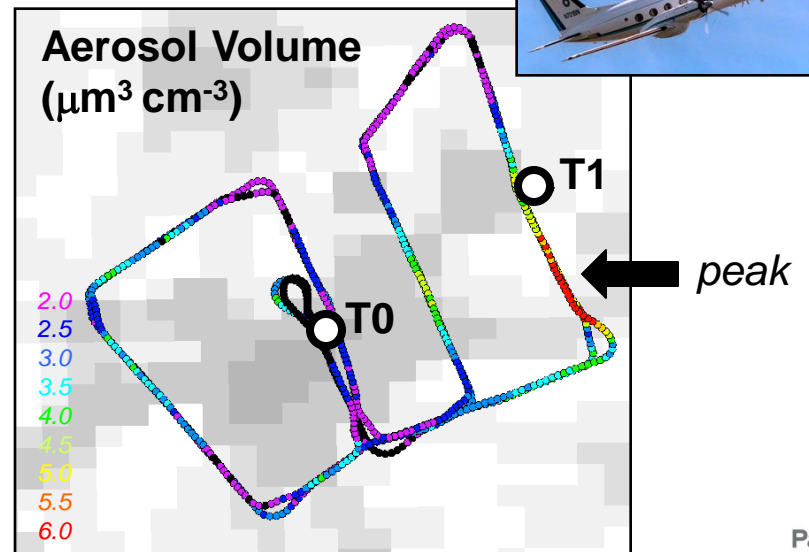
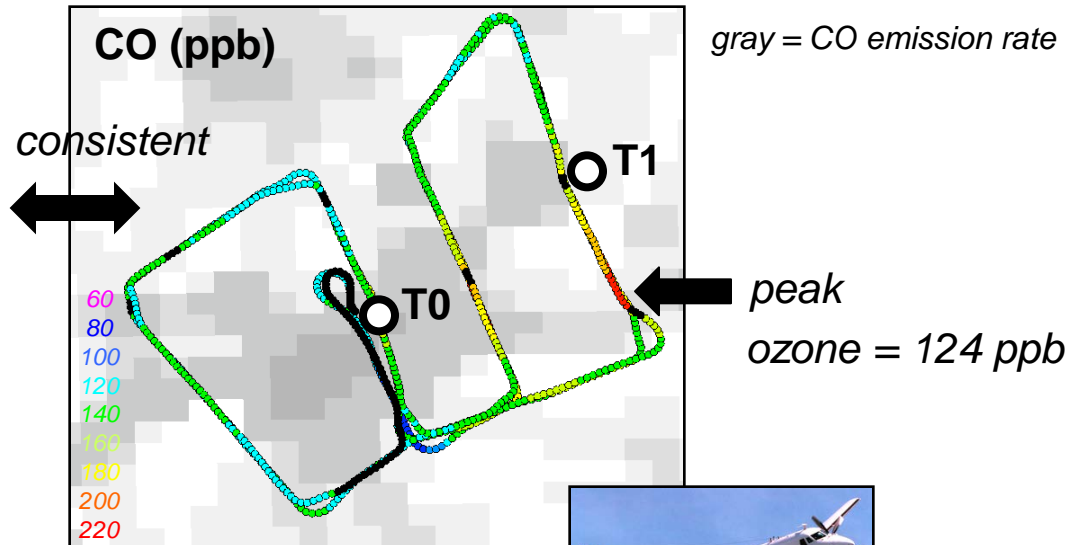
# Intense Photochemical Evolution on June 28

## WRF Tracer Forecast 16 PST



WRF forecast: W. Gustafson and J. Fast

## G-1 Data, 1341 – 1641 PST



# Emerging Topics

## ▶ SOA Formation

- Dominated by biogenics
- Biomass burning OA may be important – need PMF and multilinear regression to separate the different sources
- Role of organic nitrates and potential interactions between anthropogenic and biogenic precursors?

## ▶ BC aging, Coarse Particles, and Light Absorption

- Aircraft and ground based SP2 data suggest rapid aging of BC
- SPLAT II data at T0 can give mixing state evolution
- Specific BC absorption increases with aging
- MFRSR data suggests substantial role of coarse mode
- Need to investigate the effect of aerosol size and mixing state on optical properties (local closure)

## ▶ CCN Activation

- Need to investigate the effect of mixing state on hygroscopicity and CCN activation

# Papers

- ▶ Overview of CARES – Zaveri et al.
- ▶ Overview of meteorology during CARES – Fast et al.
- ▶ Evaporation kinetics of OA – Zelenyuk et al. (published in PNAS)
- ▶ Mass absorption coefficients – Flowers et al.
- ▶ Cycling of CO<sub>2</sub> and biogenics at T1 – Flowers et al.

# Overview of CARES paper outline

## ▶ Introduction

- Background on the role of carbonaceous aerosols on climate
- CARES science and modeling objectives

## ▶ Sampling sites and aircraft

- Description of geographical area and sites
- Instrument suites and payload tables

## ▶ Overview of key data

- Show key time series, ratios, correlations, spatial plots to show robustness of the comprehensive CARES dataset
- Demonstrate that the data will be able to address the stated science and modeling objectives