

# PALMS Single-Particle Composition DC3 Aerosol Overview and Convective Outflow

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## DC3 Aerosol Properties

### Convective Redistribution of Aerosol

- Boundary layer air is lofted by into the UT by convective storm systems
- Boundary layer aerosol volume is largely mineral dust and sulfate/organic
- Removal by activation, precipitation, scavenging:
  - Soluble particles (salts, sulfate, some organics): effective CCN
  - Mineral dust and metallic: effective ice nuclei (IN)
  - BC: small particles readily scavenged
- Heterogeneous and wet chemical processes add sulfate and organic secondary aerosol mass
- Cloud dissipation leaves behind aerosol particles

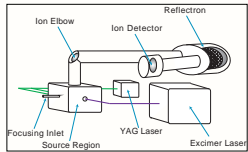


### Measurement Objectives

- Relative and absolute abundance of aerosol particle types. **Size-resolved composition.**
- Primary and Secondary aerosol particles
- Compare convective inflow and outflow in US regions (E vs W)
- Identify size- and composition-dependent removal or growth due to cloud processing
- Impact of convection on UT aerosol properties

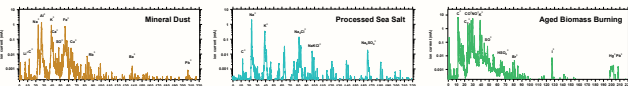
## PALMS Single-Particle Composition

### Single particle size and chemical composition



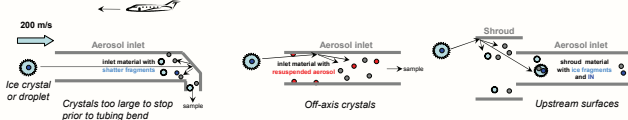
- Sample aerosol particles
- Particle detection:  
Nd:YAG laser 532nm
- Evaporation & ionization:  
UV Excimer laser 193nm
- Time-of-flight mass spec

- 1 mass spectrum (+ or -) per particle
- aerodynamic particle size: ~0.2 – 5 μm
- data rate ≤ 10Hz
- Can run autonomously

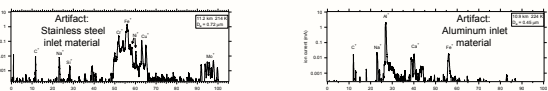


## Artifacts from Aerosol Sampling in Cloud

### Artifacts from Cloud Particle Impaction



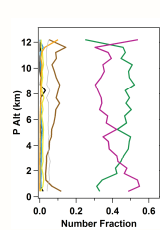
### Composition Analysis can Identify Artifacts



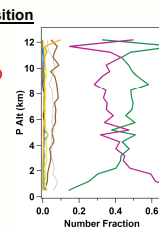
- Most aerosol measurements inside cloud are suspect
- Artifact generation depends on cloud particle size, phase, aircraft speed, inlet
- Only 1 cloud-validated inlet (Hi-CAS) flew during DC3

## DC3 Aerosol Composition Overview

### Western US



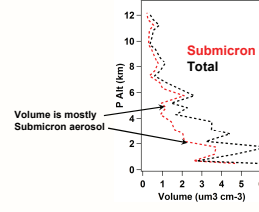
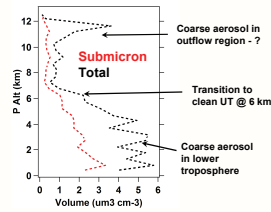
### Eastern US



### PALMS Single Particle Composition

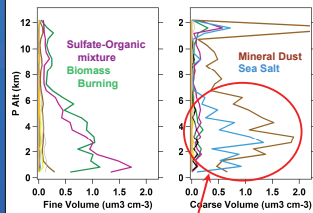
- Sulfate-Organic mixture
- Biomass Burning
- Mineral Dust
- Sea Salt
- EC
- Meteoric
- Oil Combustion

### LARGE Aerosol Volume

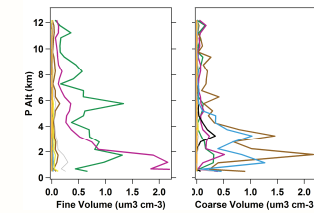


### PALMS + LARGE = Size-resolved Composition

### Western US



### Eastern US



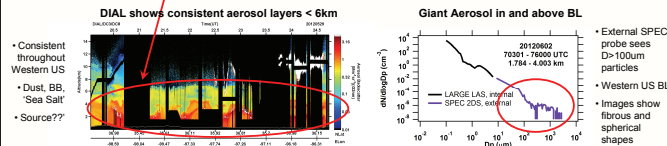
Biomass Burning Particles dominate throughout UT

Coarse aerosol is mostly Dust, some Sea Salt

Similar to West, Biomass Burning goes to higher altitudes

Similar to West, Less Dust in UT.

### Open Questions



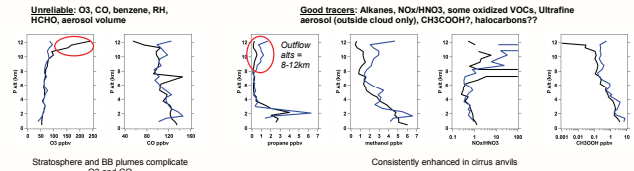
- Consistent throughout Western US
- Dust, BB, 'Sea Salt'
- Source???

- External SPEC probe sees D>100μm particles
- Western US BL
- Images show fibrous and spherical shapes

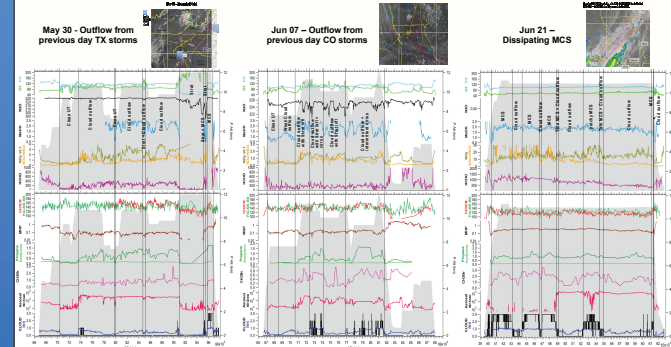
- Heavy regional Biomass Burning influence from US and Asia
- Supermicron Dust contributes substantial volume in West
- High aerosol loadings <6 km... From perturbations to BL?
- 'Sea Salt' = dry lakebed salt?

## Convective Outflow

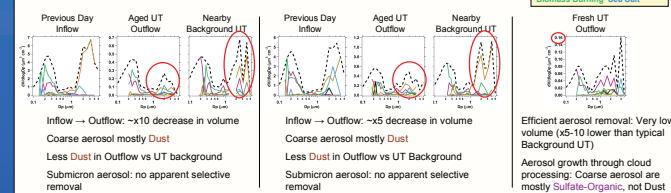
### Define Outflow Tracers



### Aged (Cloud-free) Outflow



### Aerosol size, volume, and composition



## Summary

- Many aerosol measurements are **unreliable** inside cirrus anvils
- Search for aged (cloud-free) outflow – 'Downwind' flights
- Define cloud-free outflow segments based on gas phase tracers: **Alkanes, NOx/HNO3, MeOH**. Other species provide confidence.
- Biomass burning particles** and **Mineral Dust** dominated DC3 study region
- Coarse mode Mineral Dust** shows relative decrease in aged outflow
- Other particle types: no apparent change.
- Total aerosol volume varies in outflow cases: Similar to background UT (daytime western storms) versus very clean (MCS 6/21).

### Acknowledgements:

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