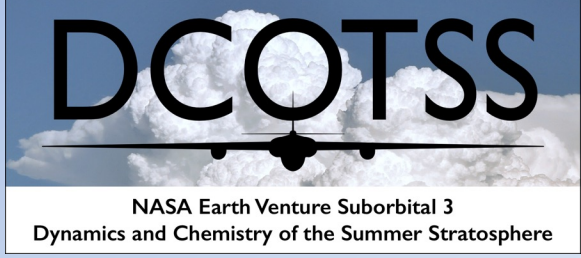
2021 Open Data Workshop
(December 7th)



Particle Analysis by Laser Mass Spectrometry – Next Generation

PALMS-NG

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Contact team member: Xiaoli Shen (xlshen@purdue.edu)

PALMS-NG measures the size and chemical composition of single particles

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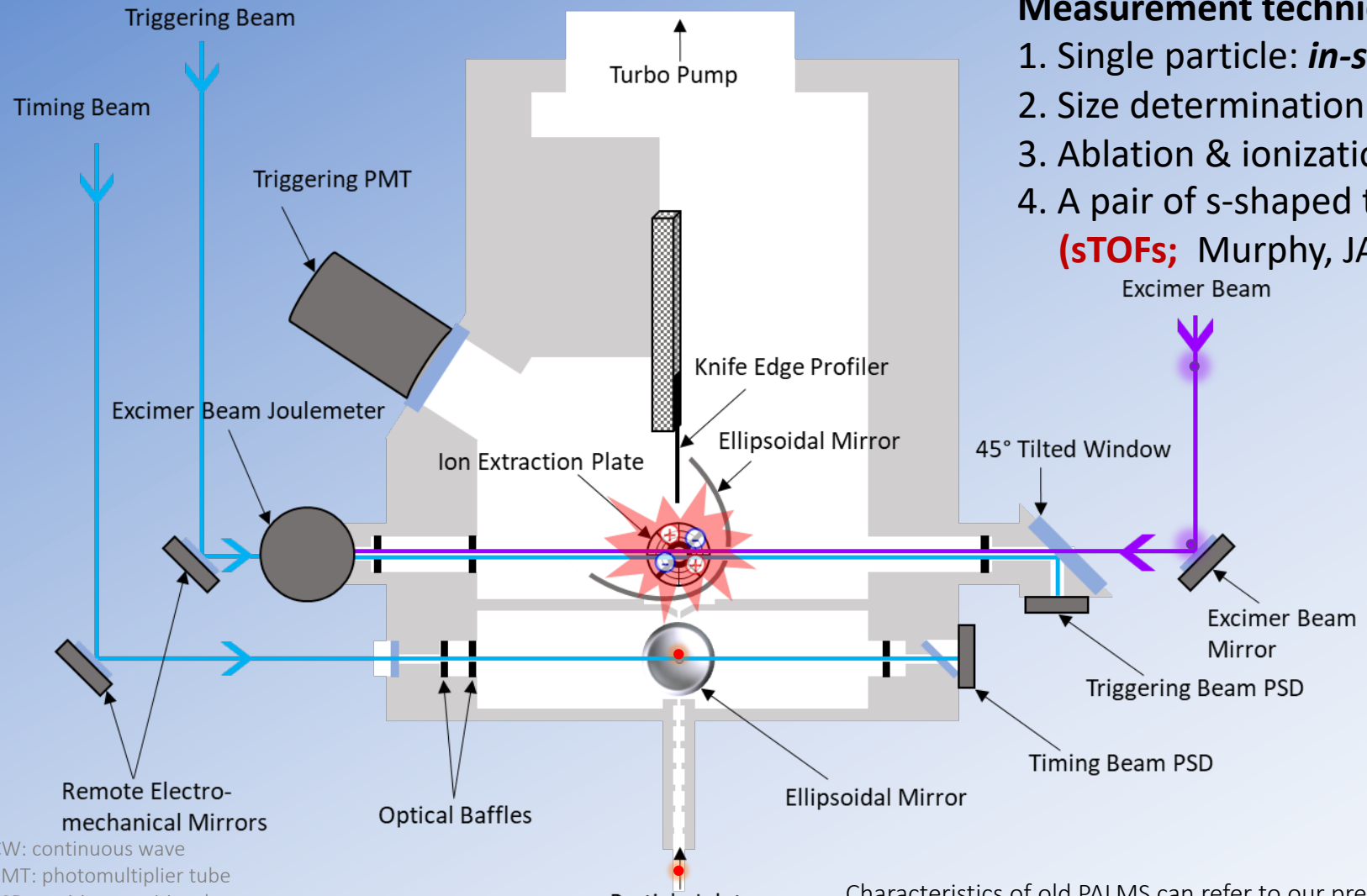
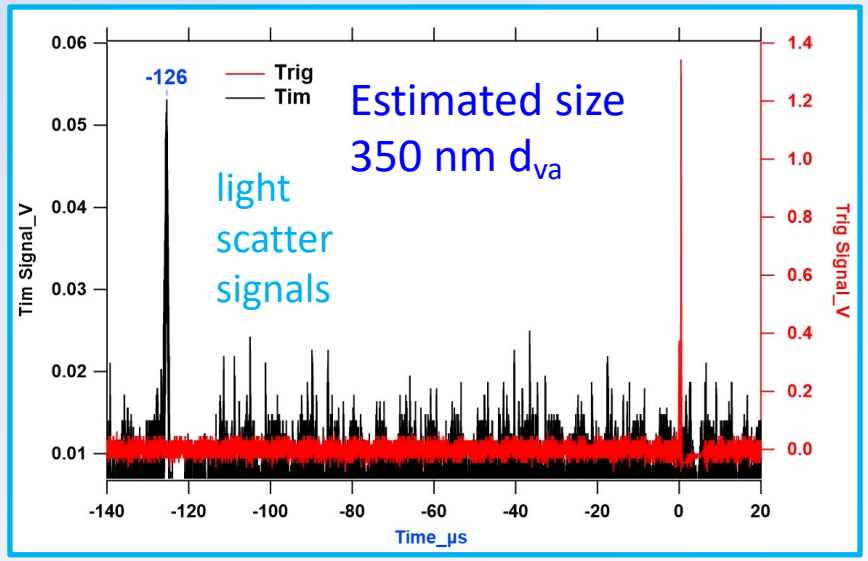
NASA Earth Venture Suborbital 3
Dynamics and Chemistry of the Summer Stratosphere



CW: continuous wave
PMT: photomultiplier tube
PSD: position sensitive detector

Measurement technique

1. Single particle: ***in-situ* & real time**
2. Size determination: **TWO CW diode lasers 405 nm**
3. Ablation & ionization: **One pulsed excimer laser 193 nm**
4. A pair of s-shaped time-of-flight mass spectrometers **(sTOFs;** Murphy, JASMS 2017**)**



Characteristics of old PALMS can refer to our previous studies (Thomson et al., AST 2000; Cziczo et al., IJMS 2006)

Data Collection/Creation Process

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1. If particle passes one laser -> scattering signal (geometric size)
2. If particle passes two lasers -> geometric and aerodynamic size
3. Mass spectra (chemical information)
4. Analyze size and mass spectra to generate particle data products

PALMS-NG data products

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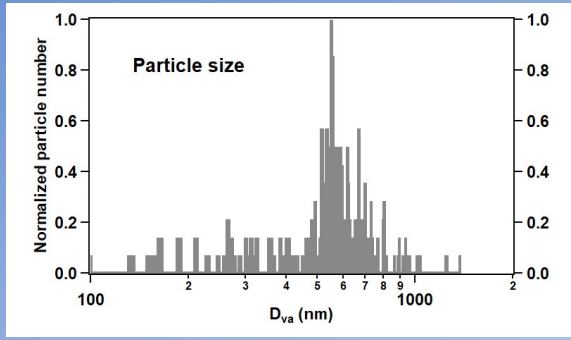
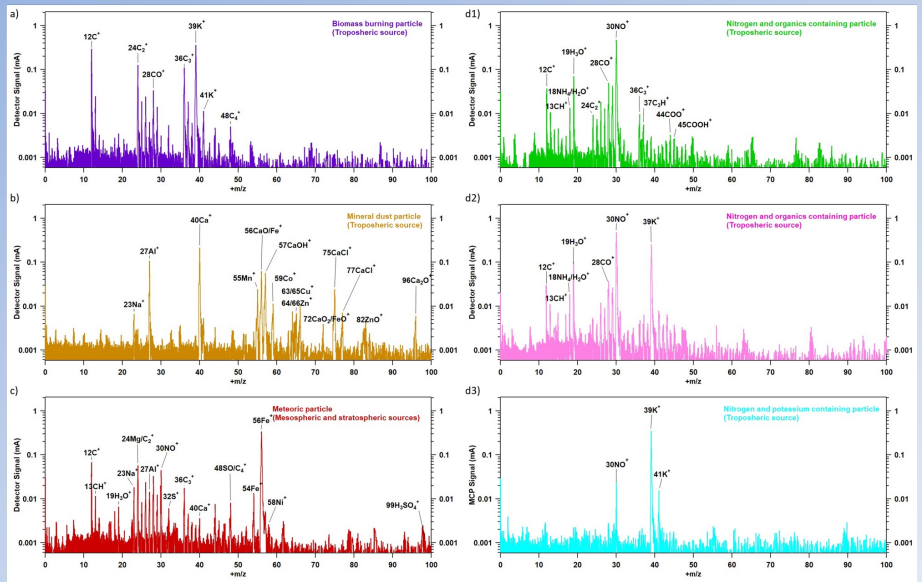
#1 Particle size



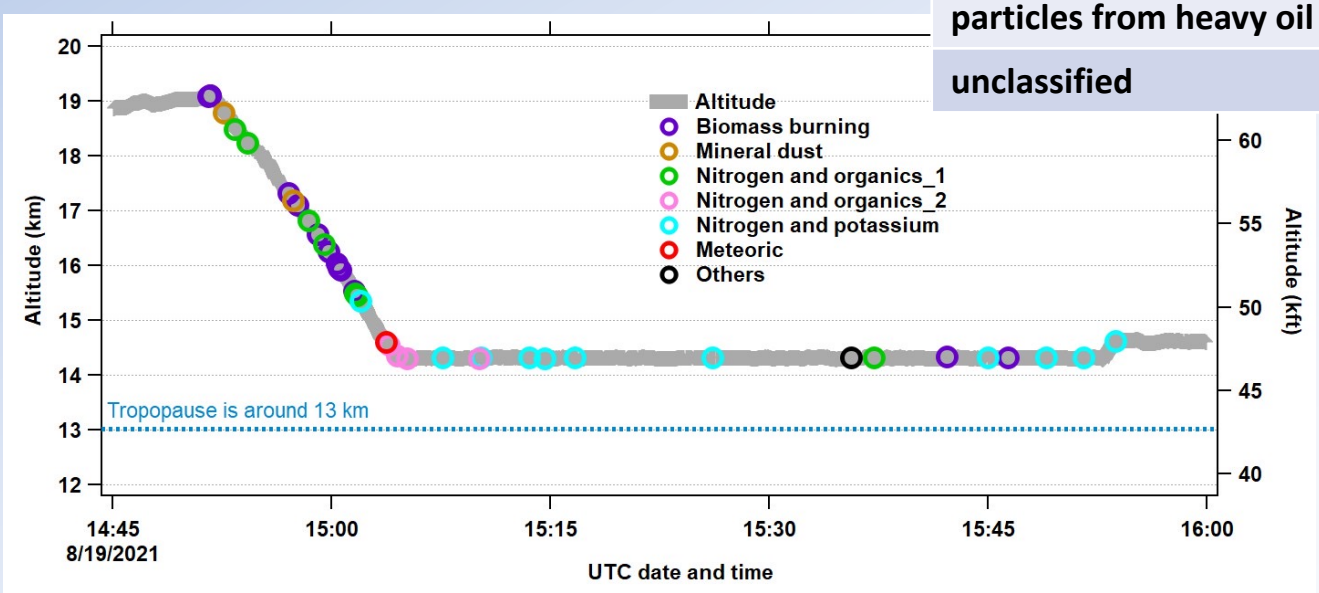
#2 Mass spectra of single particles



#3 Time series of particle type

- **Primary products:**
  Time-averaged number fraction
- **Potential:**
  Time-averaged mass concentration (with reference instrument, e.g., DPOPS)

Typical particle types
mixed sulfate-organic-nitrate
biomass burning
elemental carbon
mineral/metallic
particles with meteoric material
alkali salt
sea salt
particles from heavy oil combustion
unclassified



File Structure & Content

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- **All data products are reported as time series**
- **One ICARTT file per flight**
- **Particle type number fractions are time-averaged over ~5 min, depending on the concentrations**
- **Mass spectra and size are reported for individual particles**
- **File size: ~50 KB**

e.g., PALMS_DC8_20160729_R4.ict (ATOM-1 mission)

Data Limitations & Considerations

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Details on accuracy and precision

Typical error in automated particle classification routines yields **uncertainties of ~1% to 5%** (Froyd et al., AMT 2019).

Examples of scientific use/best practices for particle type products

- identify dominant aerosol type within an airmass
- detect dilute aerosol plumes (dust, biomass burning)
- vertical structure of tropospheric vs stratospheric particle types

***Note**: Users should not attempt to convert number fractions into absolute concentration. Please contact the PI.

Archival Timeline

DCOTSS
NASA Earth Venture Suborbital 3
Dynamics and Chemistry of the Summer Stratosphere

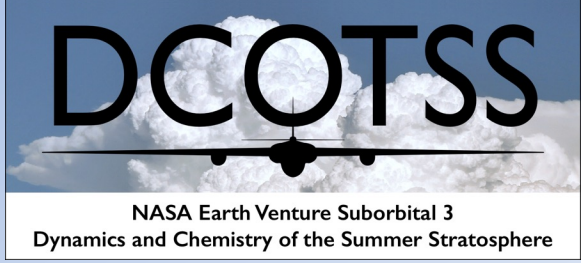
- **For selected 2021 research flights in December 2021**
- **Currently archived:**

  1. DCOTSS-PALMSNG_ER2_20210806_RA.ict (size info)

  2. DCOTSS-PALMSNG_ER2_20210819_RA.ict (chemical info)

- **All flights by February 2022**

Upcoming Conference Presentations



- **ACCESS Dec 9-11 (oral presentation, Dec 11)**

  Title: A new single particle mass spectrometer, PALMS-NG, and its first measurement of stratospheric particles

- **AGU Dec 13-17 (eLightning session, #A25A-04, Dec 14; 16:00 - 17:15 CST)**

  Title: Investigation of the impact of strong summer storms on stratospheric particles with a newly developed single particle mass spectrometer, PALMS-NG