

Initial High Spectral Resolution Lidar Results From the Cumulus Humilis Aerosol Processing Study (CHAPS) and Cloud and Land Surface Interaction Campaign (CLASIC)

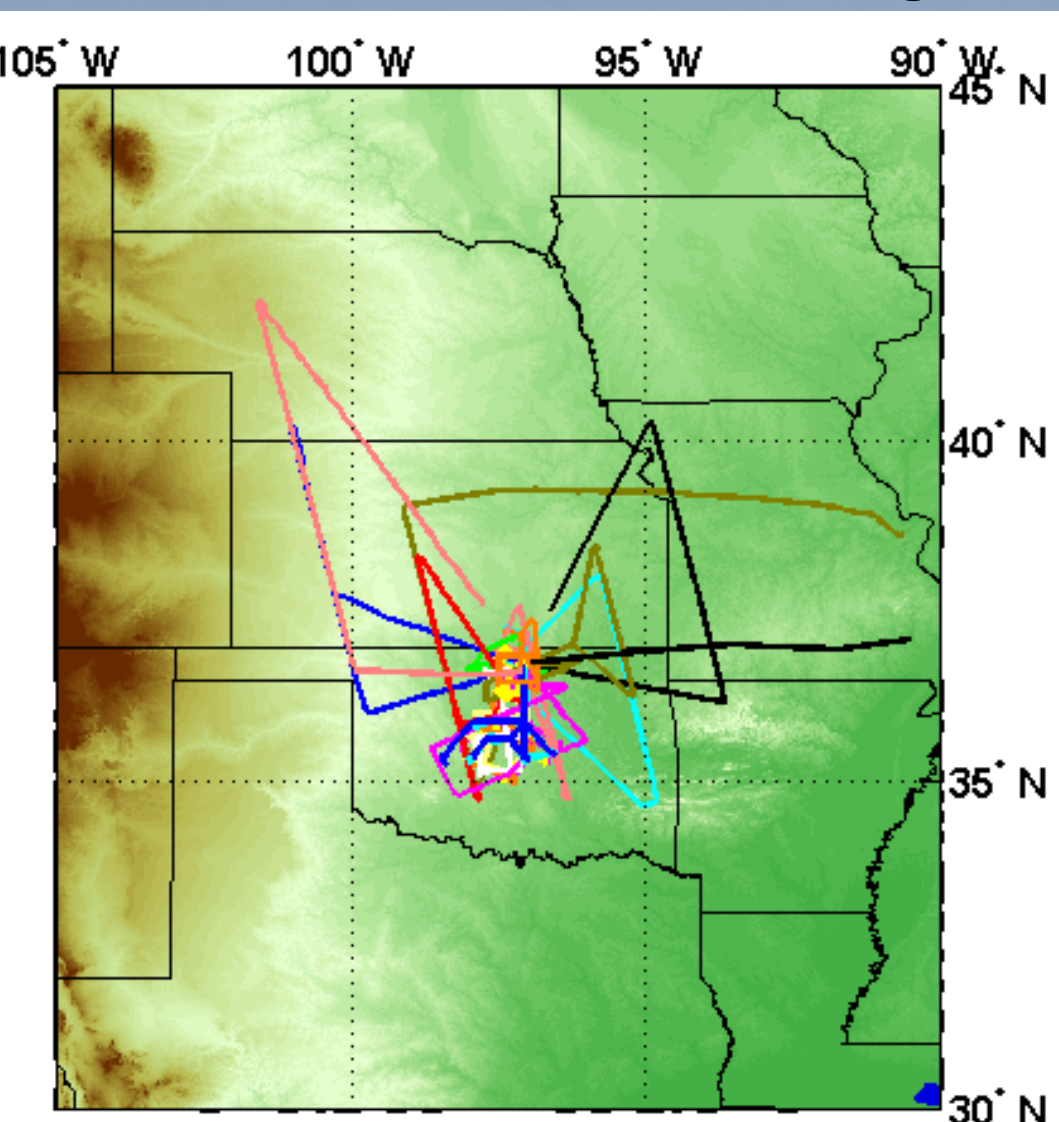
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CLASIC/CHAPS Objectives and Flights

Objectives:

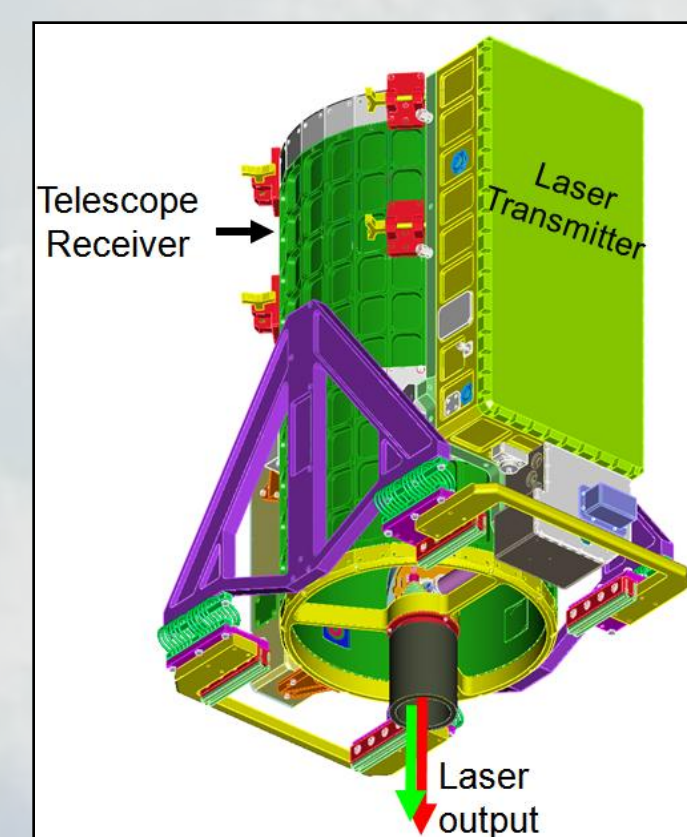
- Provide vertical profiles of aerosol between and above cloud
 - Provide vertical context for DOE G-1 measurements
 - Investigate changes in aerosol optical properties as a function of:
 - Distance from clouds
 - Proximity to urban center (ex. upwind vs. downwind of OKC)
- Provide cloud top and PBL heights
- Locate horizontal extent of OKC plume
- Use HSRL measurements of aerosol intensive parameters to infer aerosol types
- Validate CALIOP lidar on the CALIPSO satellite
- Assess aerosol measurements of existing passive satellite sensors
 - MODIS, MISR, PARASOL
- Acquire data over DOE ARM SGP Raman lidar to investigate advanced, multi-wavelength lidar retrievals



20 science flights,
66 flight hours

- ~12 flights over ARM SGP
- ~8 flights coordinated with CALIPSO satellite overpasses
- ~8 flights coordinated with DOE G-1
- ~4 flights coordinated with CIRPAS TO
- ~10-12 flights with MODIS/MISR

NASA Langley airborne High Spectral Resolution Lidar (HSRL)



Capabilities:

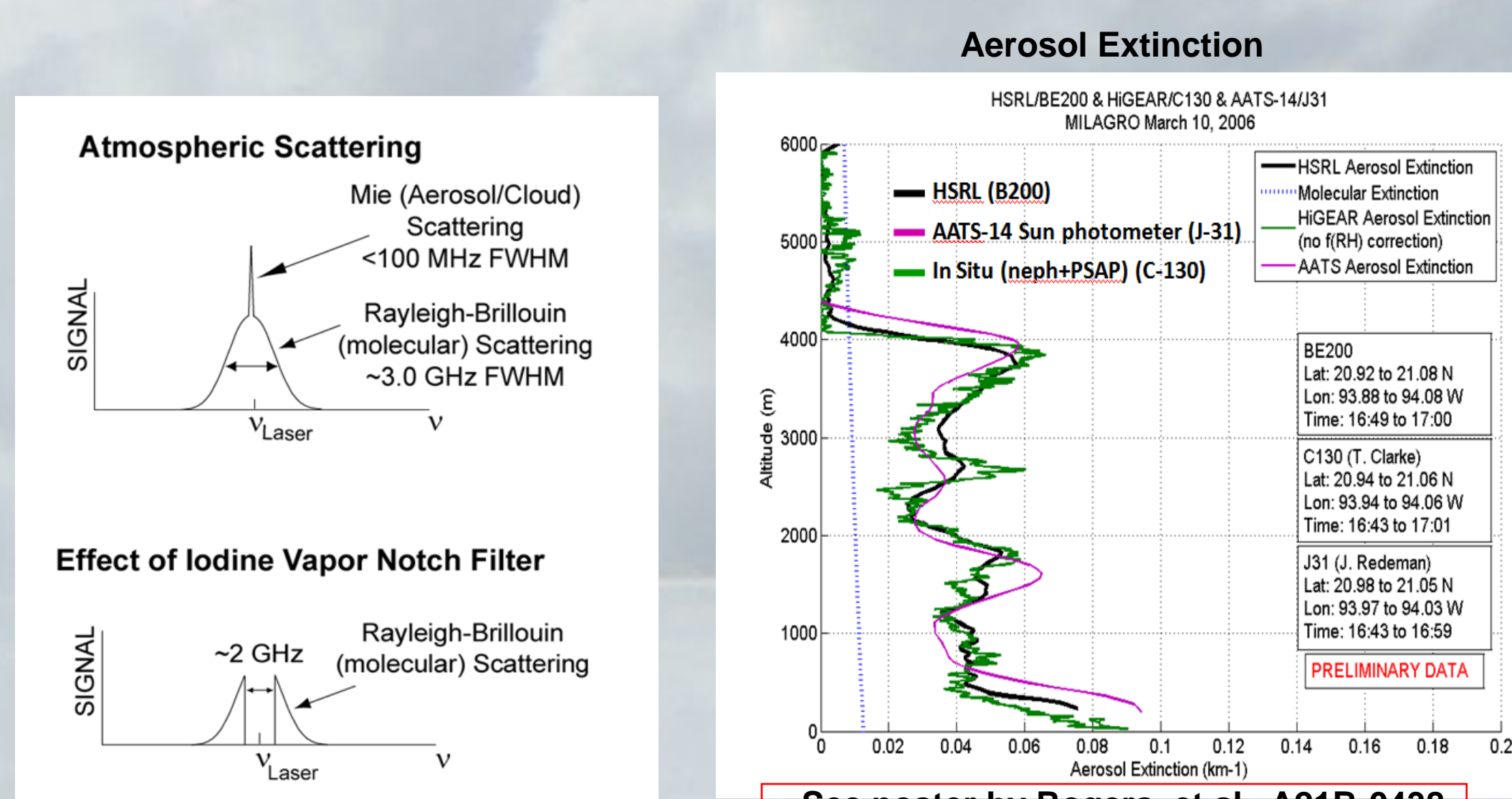
- HSRL at 532 nm (iodine technique)
- Aerosol backscatter and extinction (532 nm)
- Backscatter lidar at 1064 nm
- Depolarization at both 532, 1064 nm

History

- 2000-2004: instrument development and Integration
- Dec 2004: first test flight on Lear 25-C
- Dec 2005: first test flight NASA Langley King Air
- 2006: flew on 3 major campaigns: MILAGRO (55 hours), TexAQS/GoMACCS (90 hours), CALIPSO Val (51 hours)
- 2007: flew on 3 campaigns: San Joaquin (EPA) (43 hours), CHAPS/CLASIC (70 hours), NASA CALIPSO/CATZ (50 hours)

Almost 400 hours of data over two years!

HSRL relies on spectral separation of aerosol and molecular backscatter in lidar receiver:

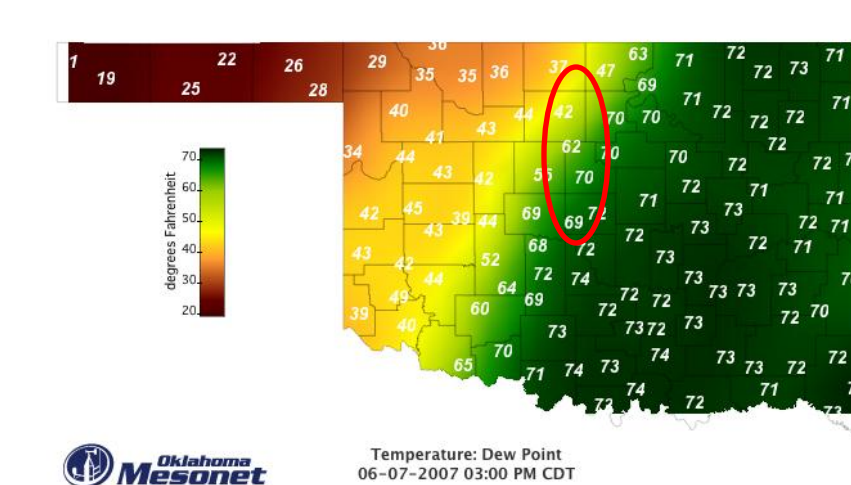


- HSRL independently measures aerosol and molecular backscatter
- Can be internally calibrated
 - No correction for extinction required to derive backscatter profiles
 - More accurate aerosol layer top/base heights
 - Provide *intensive* optical data from which to infer aerosol type

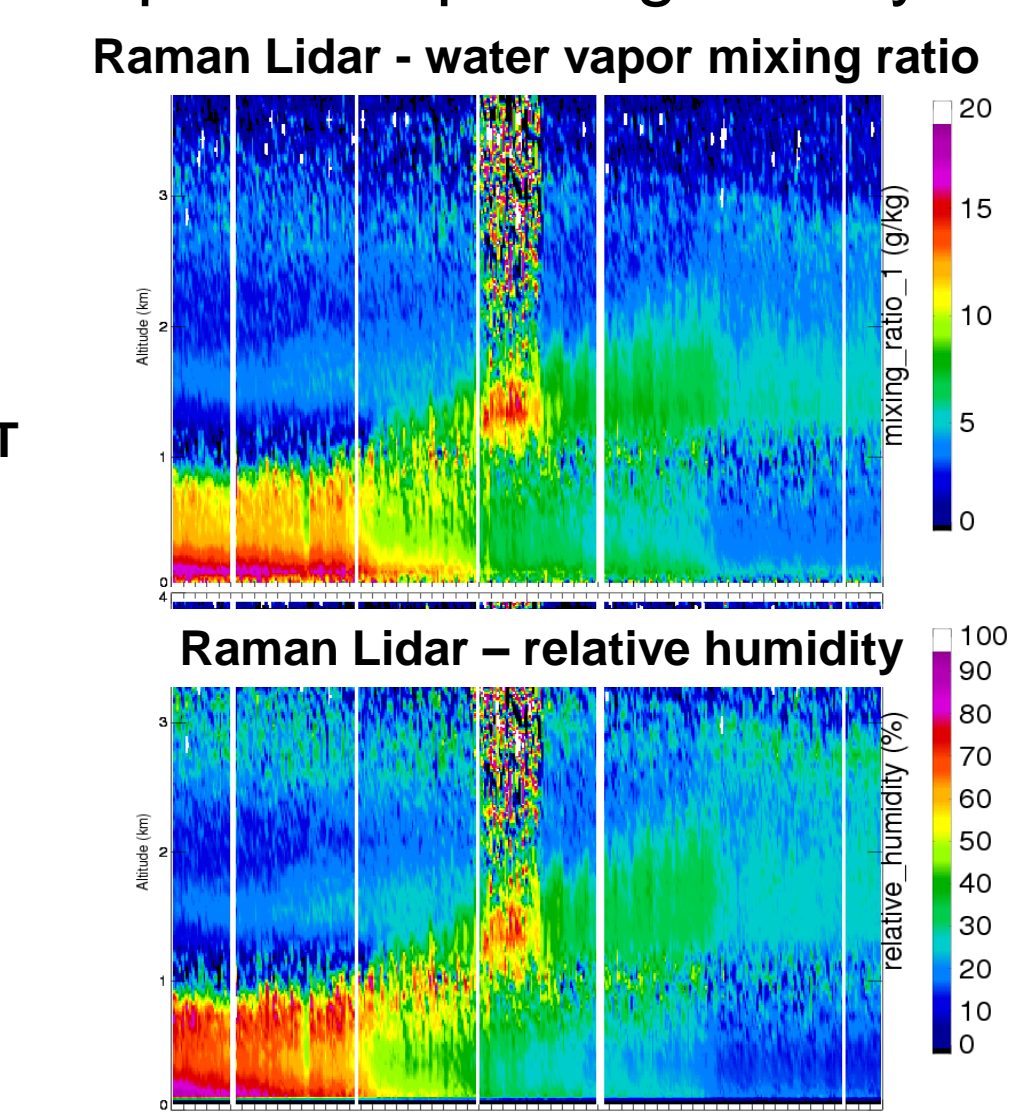
Water vapor and Aerosol Measurements of Dry Line – June 7th

Dry line passed from NW to SE over SGP site and crossed the region between the SGP and OKC:

OK Mesonet; Surface Dew Point 20:00 UT

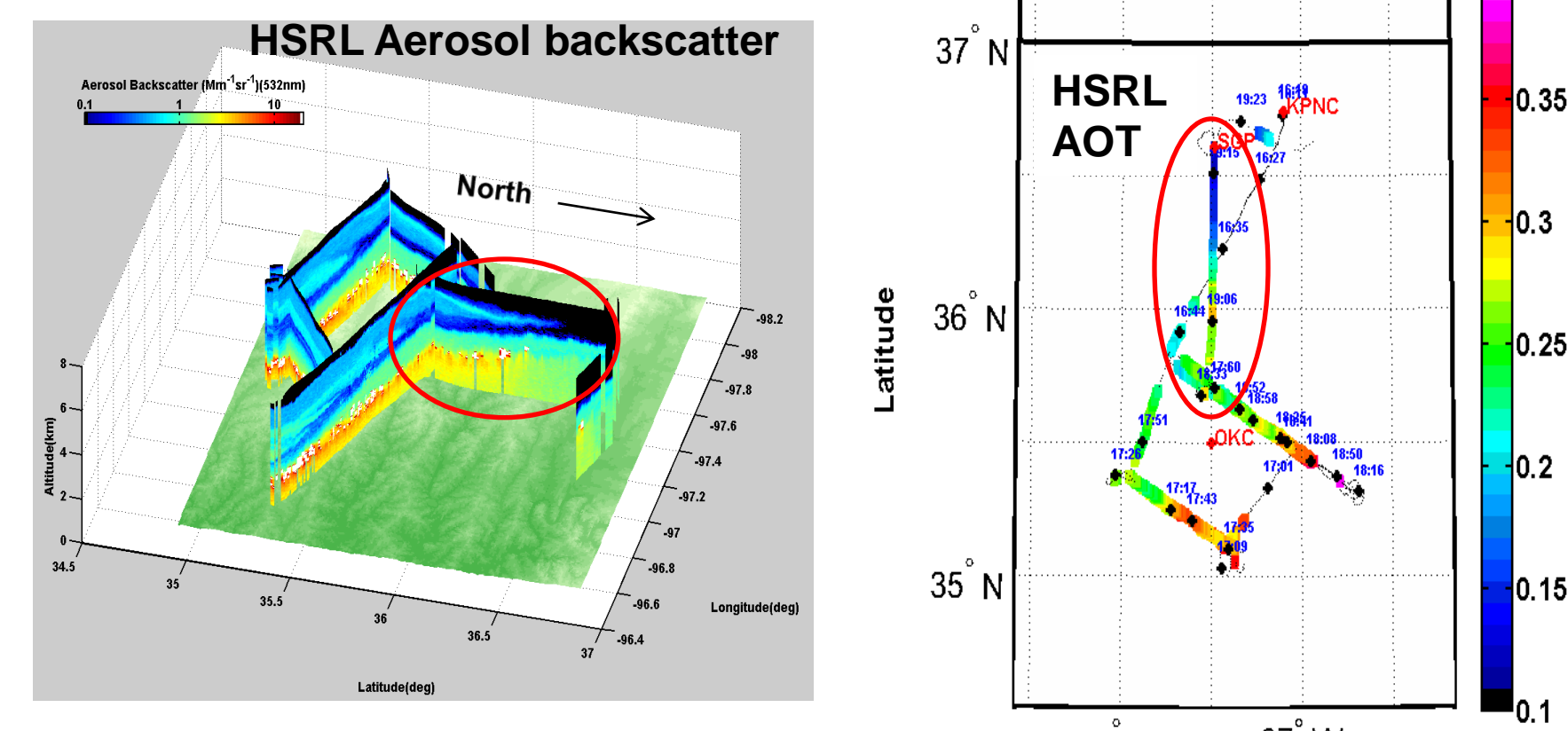


SGP Raman Lidar measurements show large decrease in water vapor after passage of dry line:



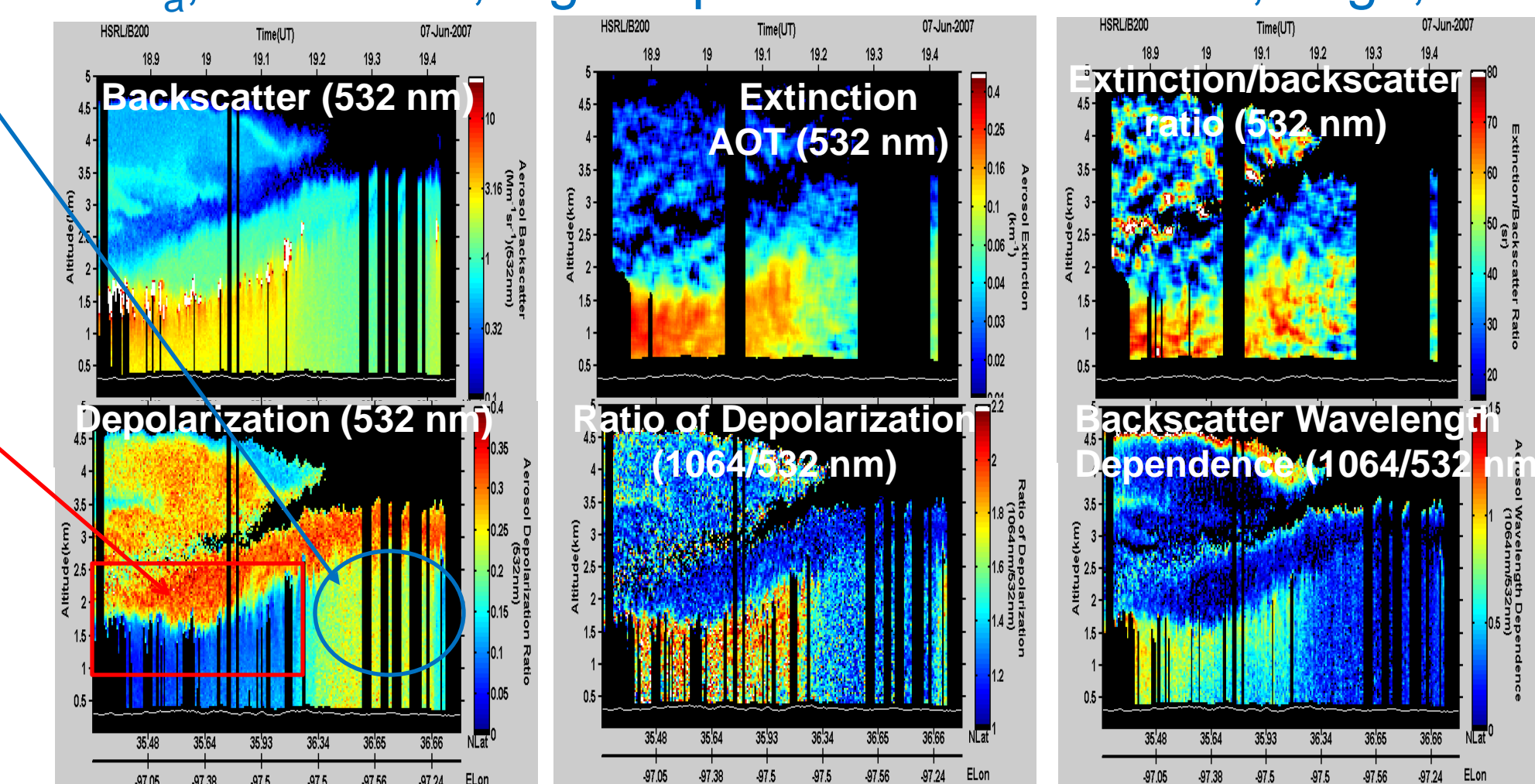
HSRL measurements show:

- high AOT ahead (SE) of dry line in OKC region
- large decrease in AOT behind (NW) of dry line



Using LaRC Airborne HSRL Measurements between OKC and SGP over dry line, June 7, 2007, to characterize the spatial distribution of aerosol type:

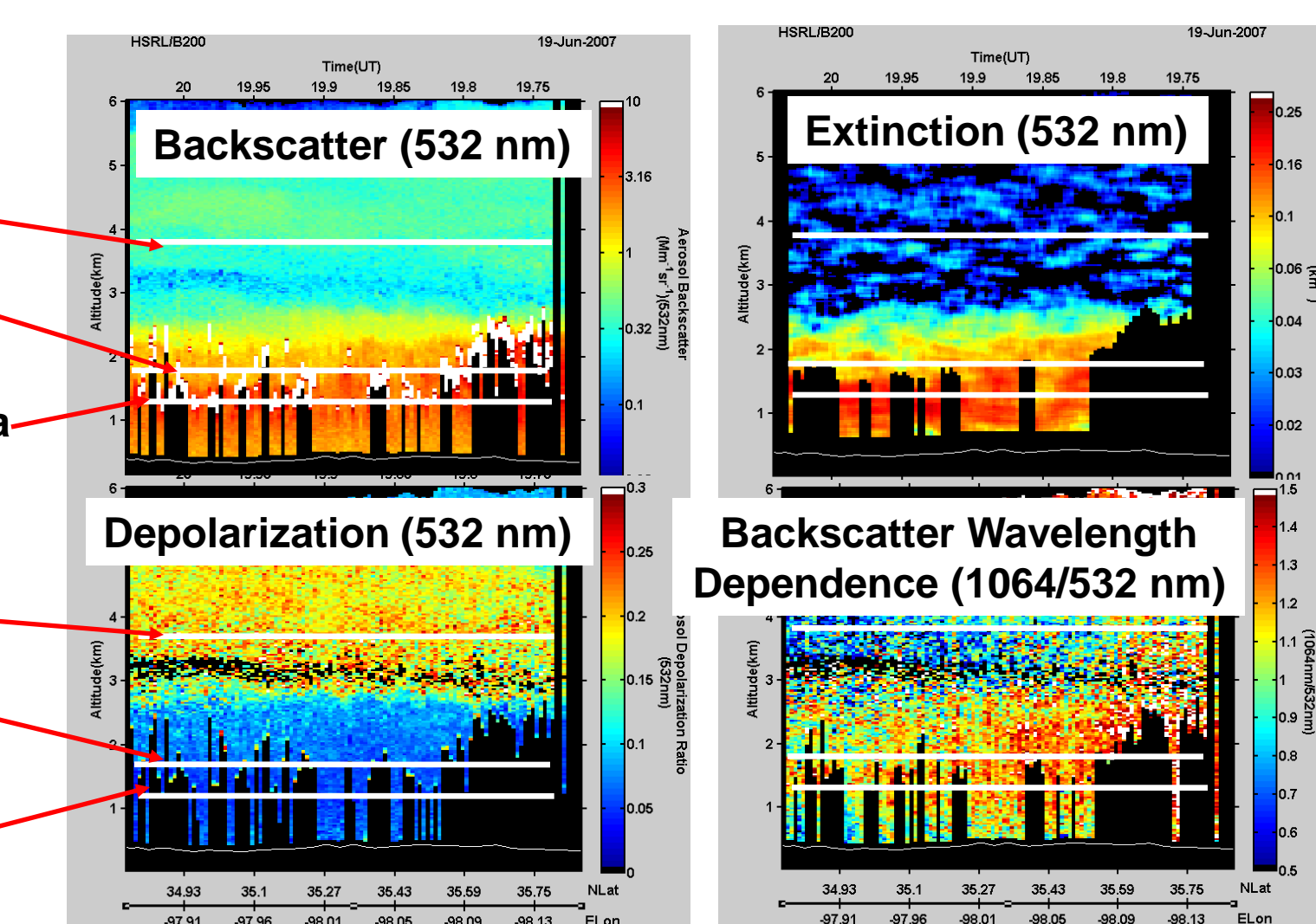
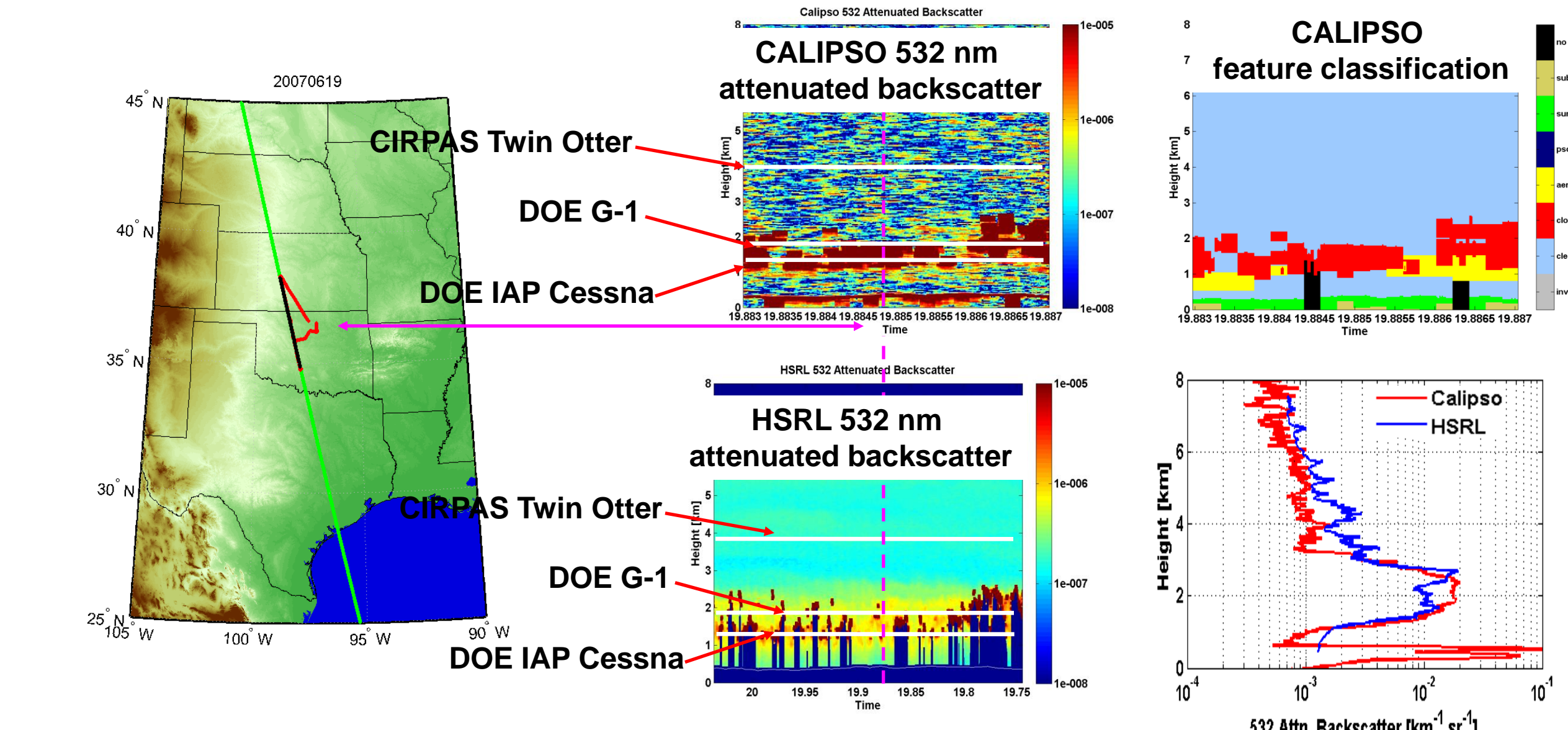
- South, OKC, humid - high S_a , high WVD, low depolarization – urban, small, spherical
- North, SGP, dry - low S_a , low WVD, high depolarization – dustlike, large, nonspherical



CALIPSO Validation – June 19th

Multi-aircraft coordinated flight along CALIPSO track:

- HSRL measurements indicate elevated layer of larger, nonspherical aerosols above smaller, spherical aerosols in PBL
- In situ measurements on DOE aircraft provide detailed measurements to assess CALIPSO and HSRL measurements

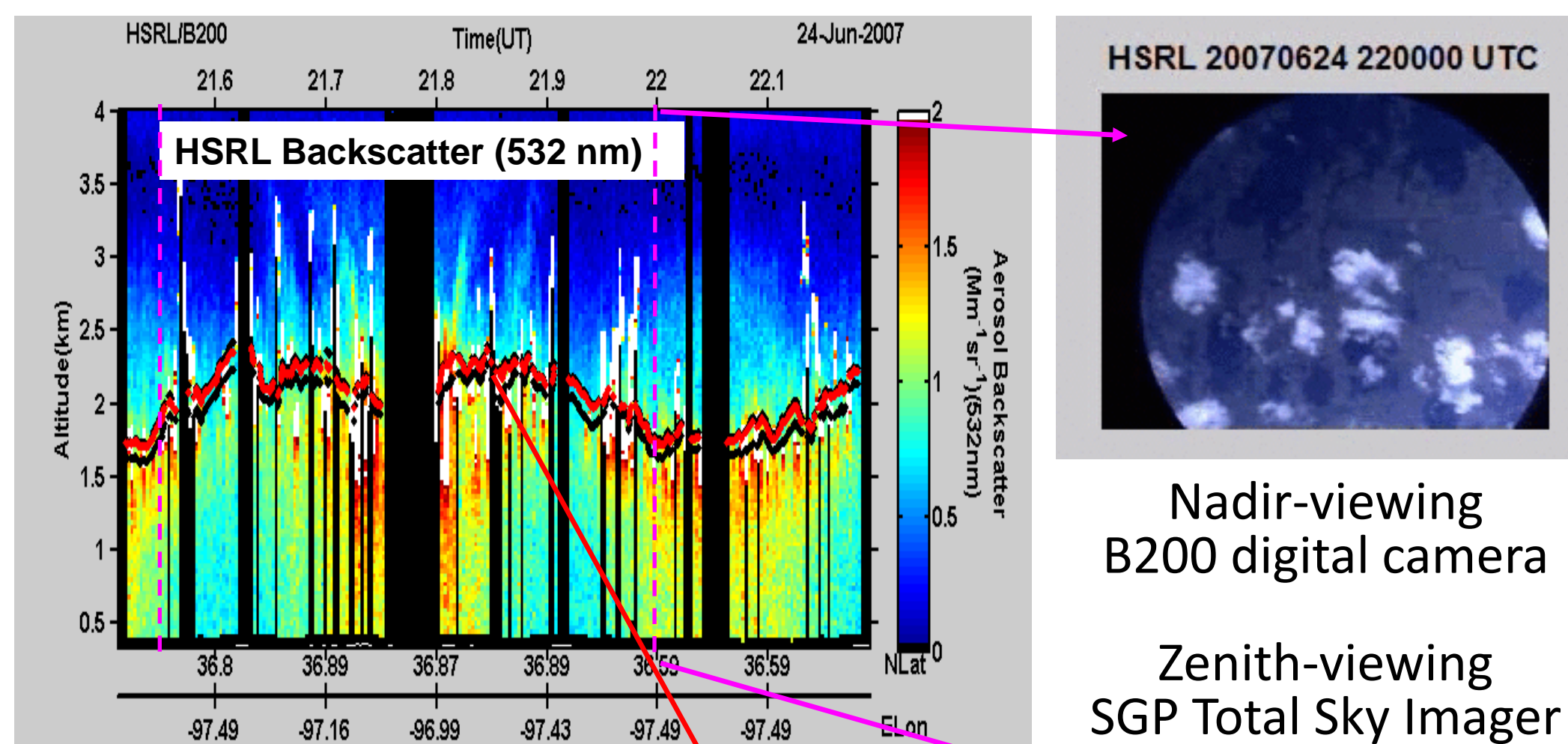


Example of CLASIC/CHAPS Coordinated Flights – June 24th

Measurements over SGP Raman Lidar

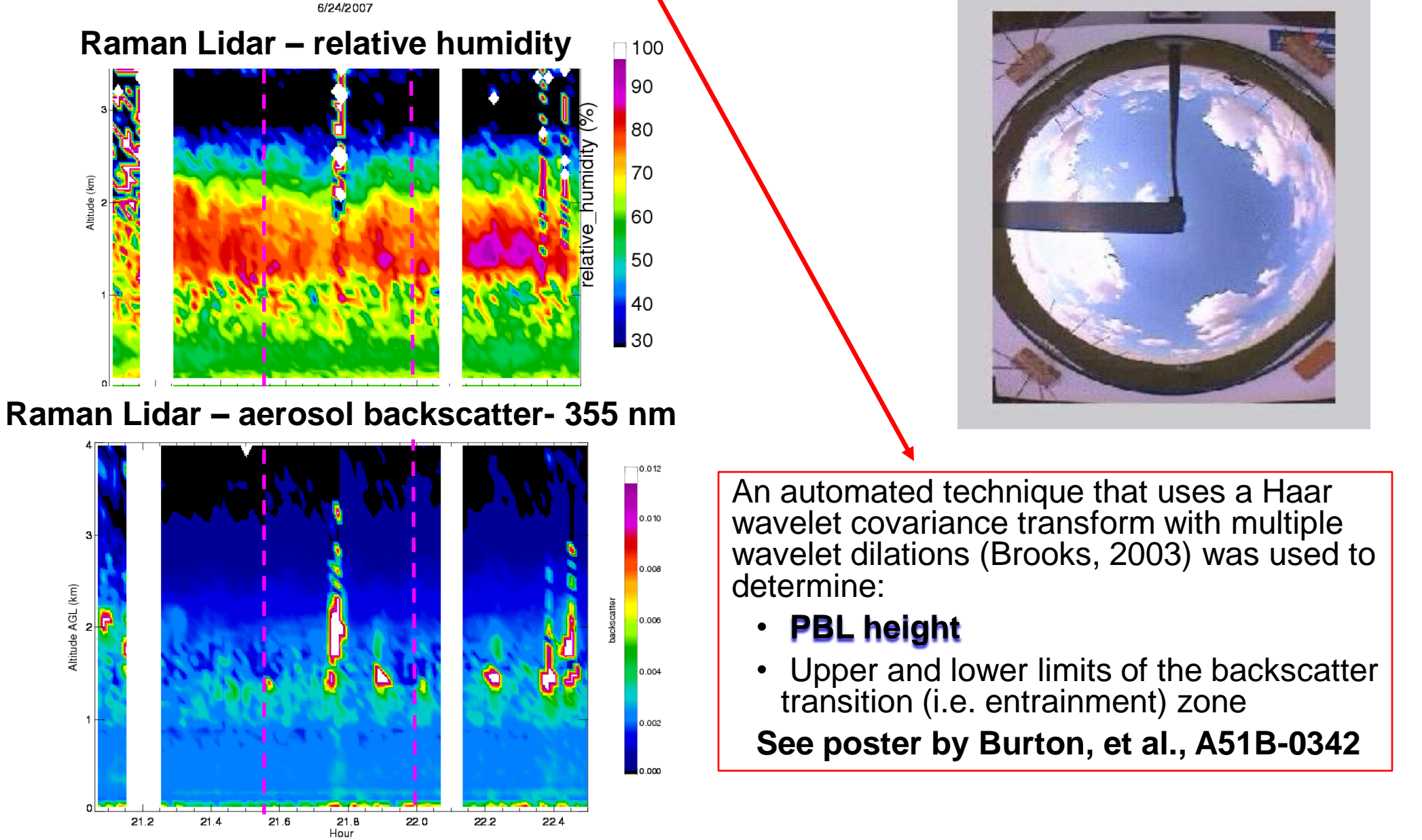
HSRL measurements acquired over DOE ARM SGP Raman lidar to investigate:

- Advanced, multi-wavelength lidar retrievals
- Investigate changes in aerosol optical properties as a function of:
 - RH
 - Distance from clouds



Nadir-viewing B200 digital camera

Zenith-viewing SGP Total Sky Imager



An automated technique that uses a Haar wavelet covariance transform with multiple wavelet dilations (Brooks, 2003) was used to determine:

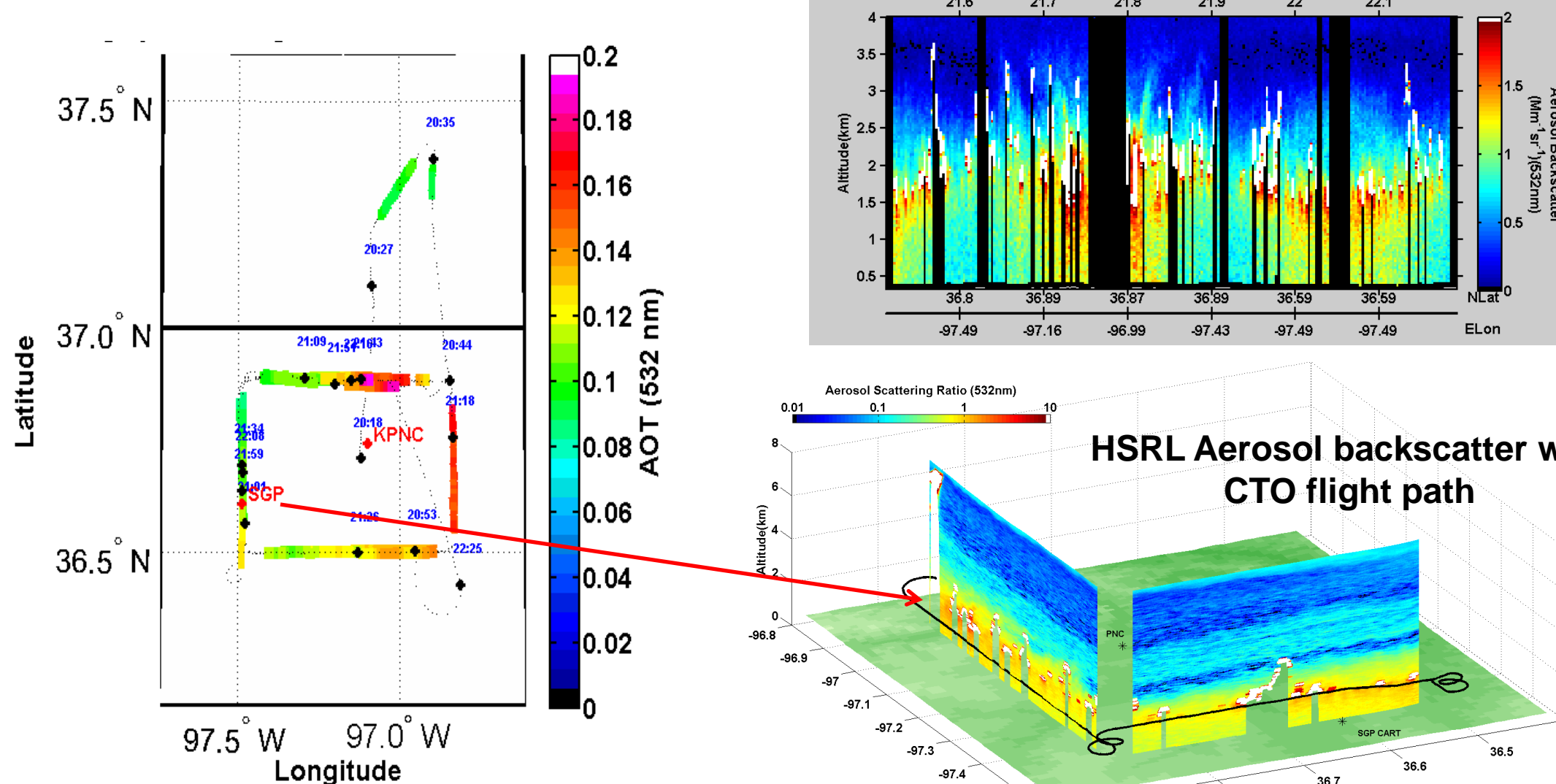
- PBL height
- Upper and lower limits of the backscatter transition (i.e. entrainment) zone

See poster by Burton, et al., A51B-0342

CLASIC B200/CIRPAS Twin Otter Coordinated Flight

HSRL measurements:

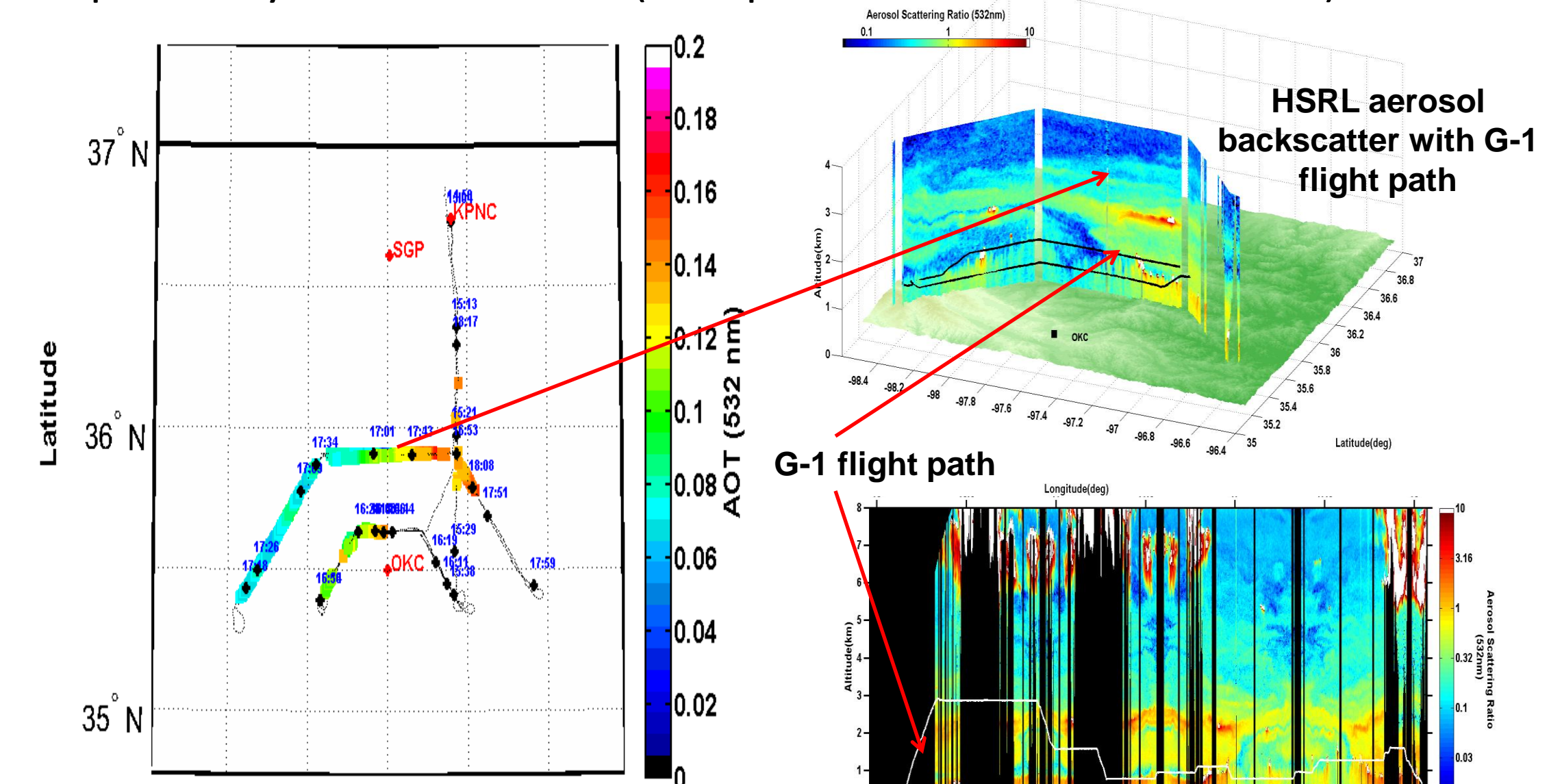
- Provide vertical profiles of aerosol between and above cloud
- Provide vertical context for Twin Otter measurements
- Investigate changes in aerosol optical properties as a function of distance from clouds



CHAPS B200/G1 Coordinated Flight

HSRL measurements:

- Provide vertical context for G-1 measurements
- Investigate changes in aerosol optical properties as a function of proximity to urban center (ex. upwind vs. downwind of OKC)



Summary and Plans for CHAPS/CLASIC

NASA Langley airborne HSRL: Investigations planned or underway to:

- Study changes in aerosol optical properties as a function of:
 - Distance from clouds (in "Twilight Zone")
 - Proximity to urban center (ex. upwind vs. downwind of OKC)
- Provide cloud top and PBL heights and AOT within PBL
- Locate horizontal extent of OKC plume
- Infer aerosol types and partition AOT by type
- Validate CALIOP lidar on the CALIPSO satellite
- Assess aerosol measurements of existing passive satellite sensors
 - MODIS, MISR, PARASOL
- Examine feasibility of advanced, multi-wavelength lidar retrievals

Preliminary HSRL data and images are now available to CLASIC/CHAPS investigators via ftp to ARM IOP archive

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