# UWKA Instruments for PECAN

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# Observational Goals and Instruments

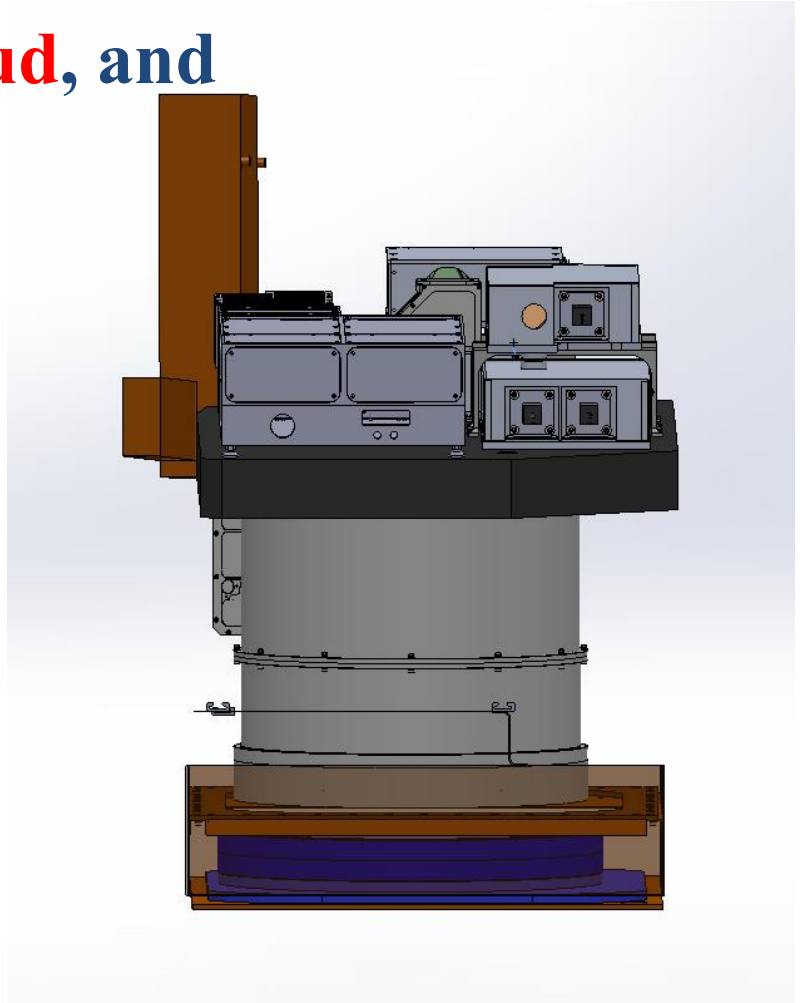
- **Flight level wind, water vapor, and temperature**
  - Traditional sensors for state variables
  - LI-COR (LI-COR 7500 or LI-COR 6262)
  - A chilled mirror hygrometer
  - Applanix (dGPS position & attitude)

- **Profiling water vapor, temperature, and aerosol profiles with Raman lidar and elastic lidar**
  - Compact Raman lidar + elastic lidar
  - Or Multi-function Airborne Raman Lidar (MARLi) + elastic lidar (depending on available power)
- **Other possible measurements** - depending on which lidar to use
  - Clouds: LWC-100 and CDP
  - Radiation: hemispheric IR and VIS up and down, plus Heitronix nadir IR thermometer

# MARLi

## —*NAF MRI under development now*

- **Profile water vapor, aerosol/cloud, and temperature simultaneously.**



**Applications**

1. Boundary layer structure
2. Cold pool development
3. Entrainment and detrainment
4. Air-sea interactions
5. …

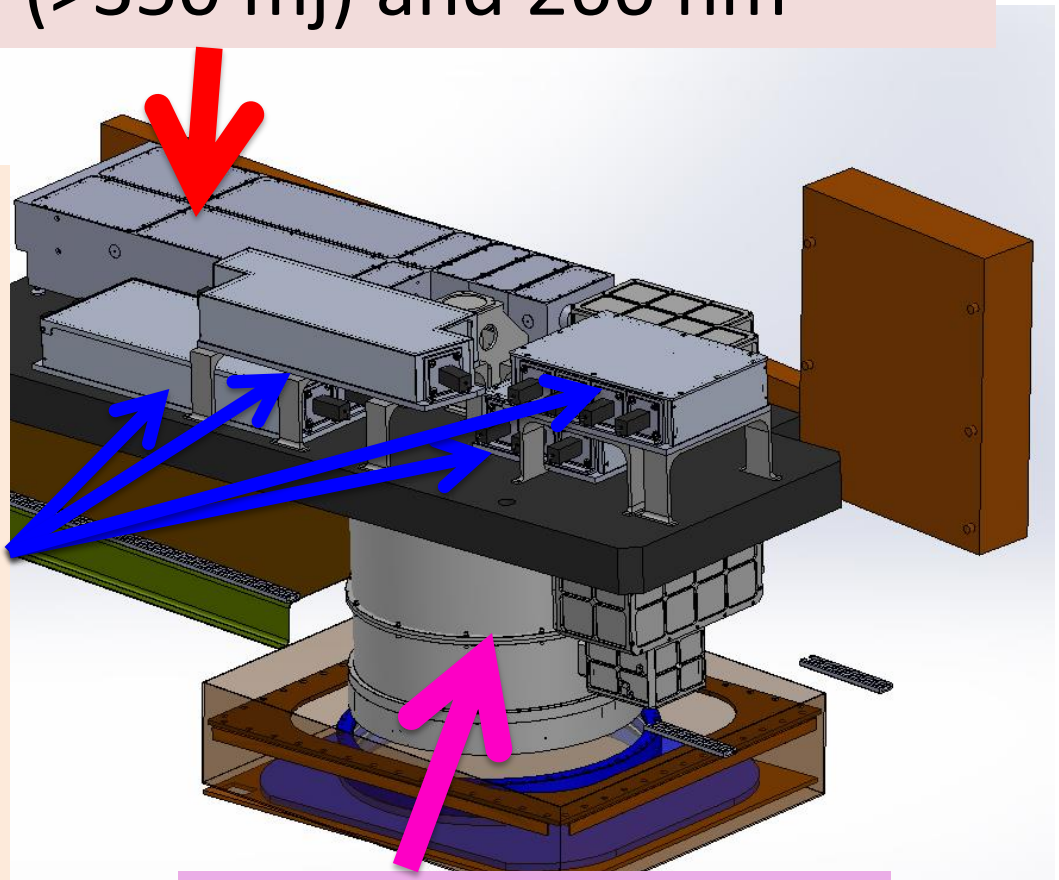
PECAN will likely be the first deployment.

# MARLi Specifications

**Laser**: 30HZ; 355 nm (>350 mj) and 266 nm

**Detection Channels**

- 355 Raman-**6**
- 266 Raman-**2**
- 266 and 355 Elastic -**5**
- A/D + photon counting or A/D only
- Raw data saved at single shots for post data analyses



**16-inch Telescope**

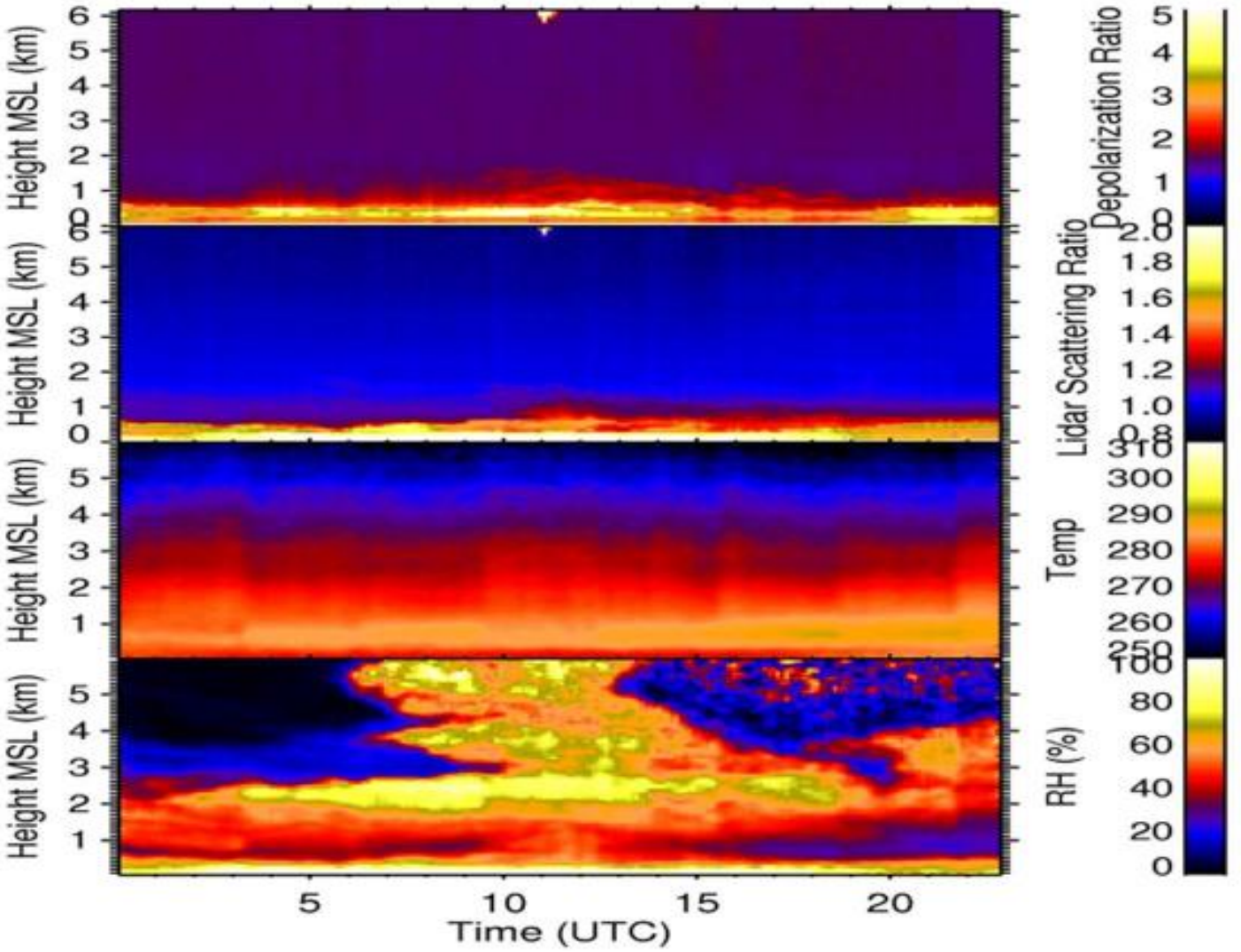
**Optimized for short range measurements!**

# An Example of Ground-base ARM Raman Lidar Measurements

Aerosols

Temperature

RH

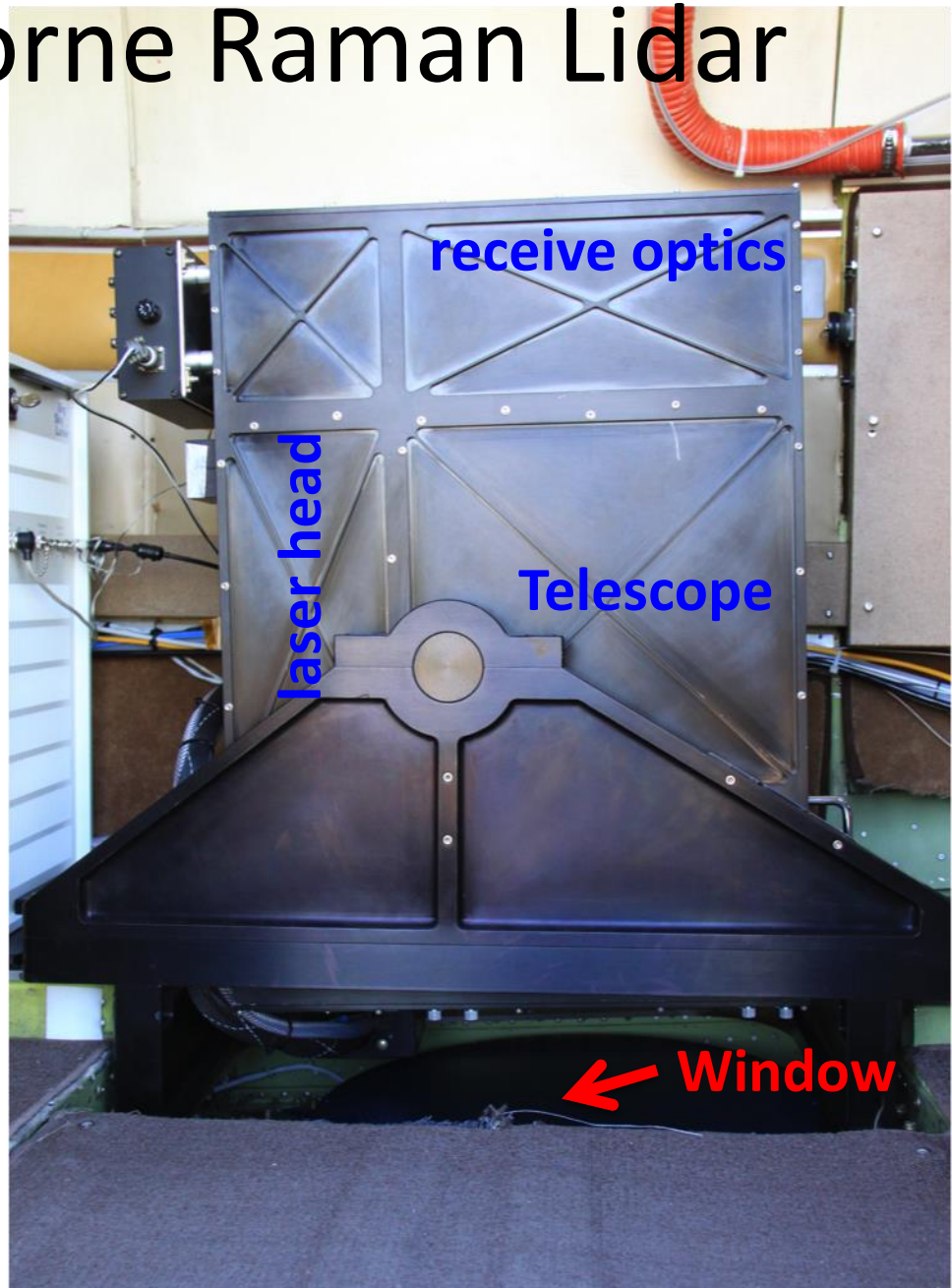


# MARLi Schedule

- Have all Parts by November.
- Have the system running in the lab after the New Year!
- Test and improve the system in the lab until March.
- During the same time—apply FAA STC for MARLi installation on King Air– Main known unknown at this time to prevent  us to have MARLi for PECAN.
- We are working hard to make it ready for PECAN.

# A Compact Airborne Raman Lidar

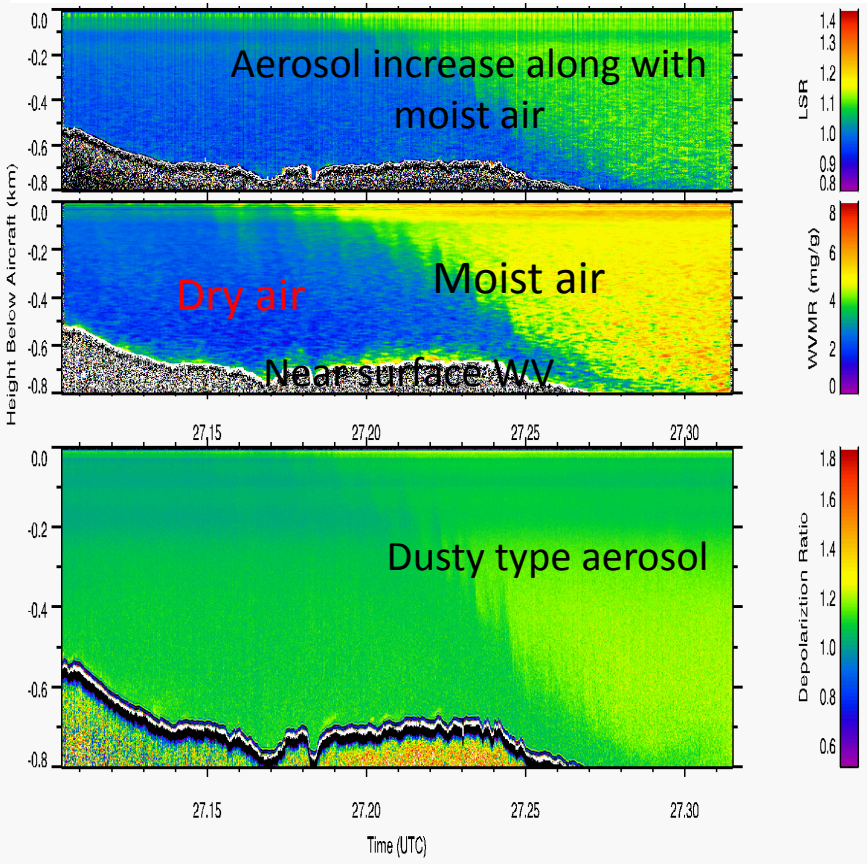
- **Compact:**
  - 12 inch telescope
  - Laser: 50 mJ at 30 Hz
  - Telescope, laser head and receive optics are integrated in one box with good optical stability.
- Four detection channels: water vapor and nitrogen Raman signals; perpendicular and parallel elastic signals.



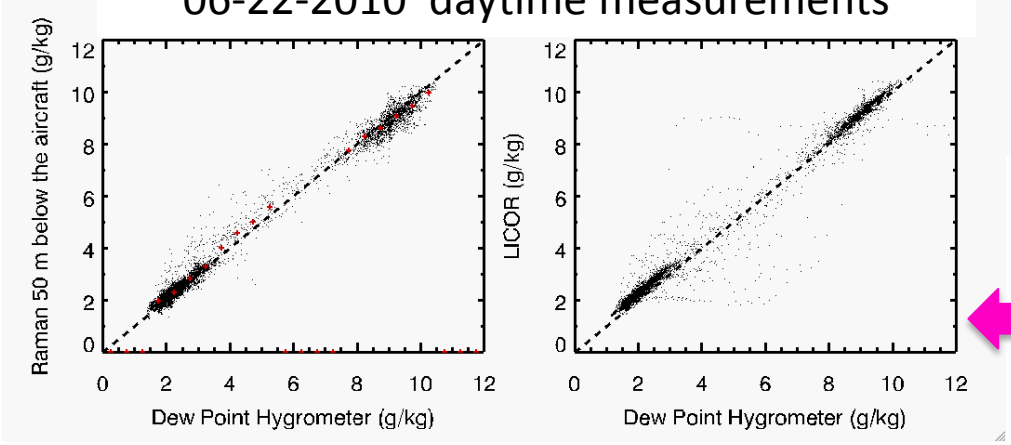
# Water Vapor Measurement Capability

- Analog detection only ( 0.75 m vertically, 15 m horizontally)
- Daytime measurement range is limited to about 500 m.
- The accuracy of water vapor: depending on post averaging.

06-17-2010 nighttime measurements




06-22-2010 daytime measurements

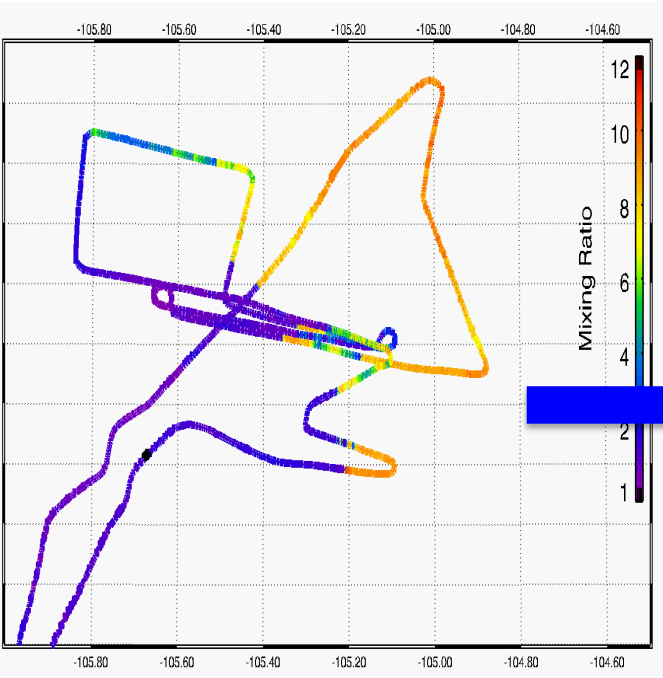



Comparisons of Raman with Hygrometer (a) and LICOR with hygrometer (b)

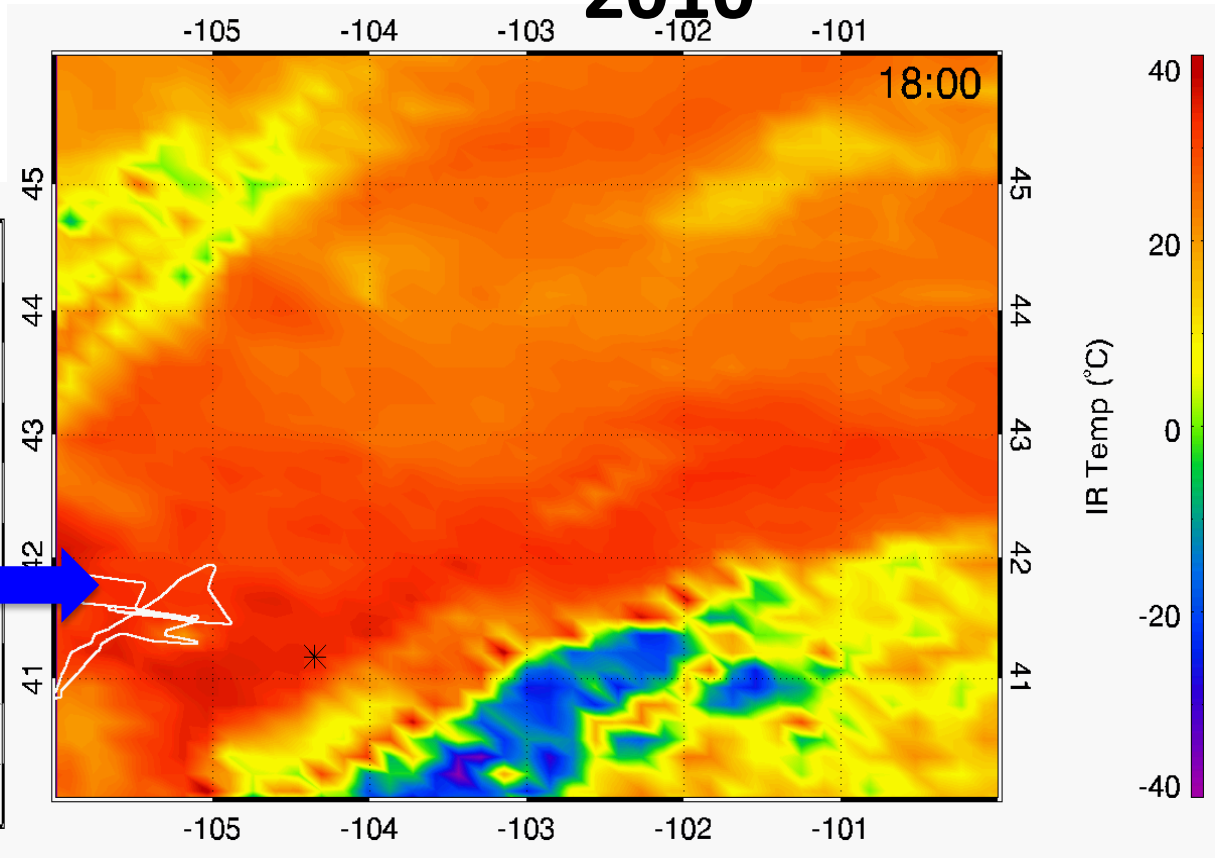
- **Response time**
- **Vertical gradient and noise**

# A Dry Line Case Observed Northeast of Laramie, WY

## Flight level (constant AGL flight) water vapor mixing ratio




## GOES IR images, June 22, 2010



# The Dry Line and Convective Initiation

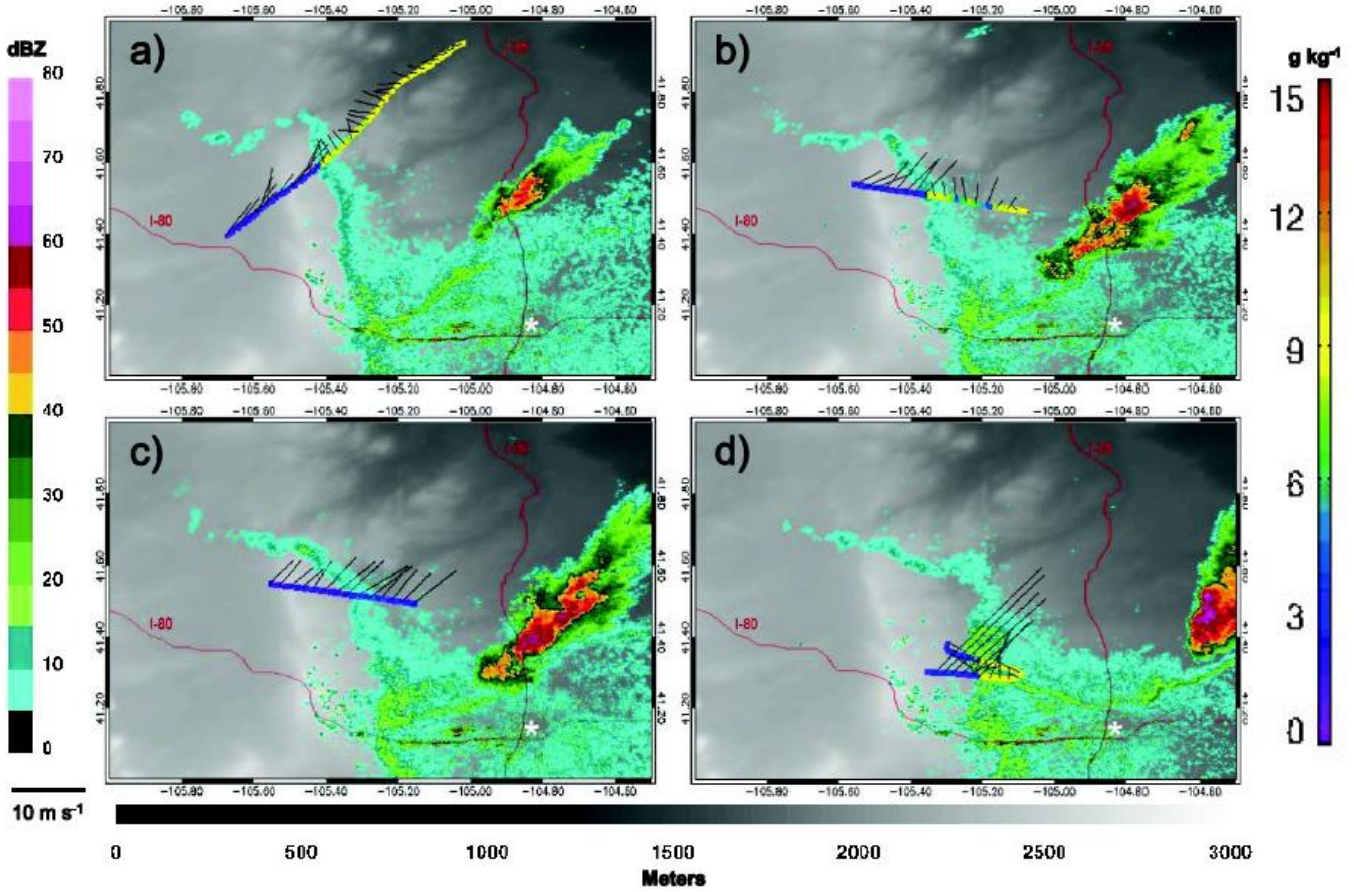
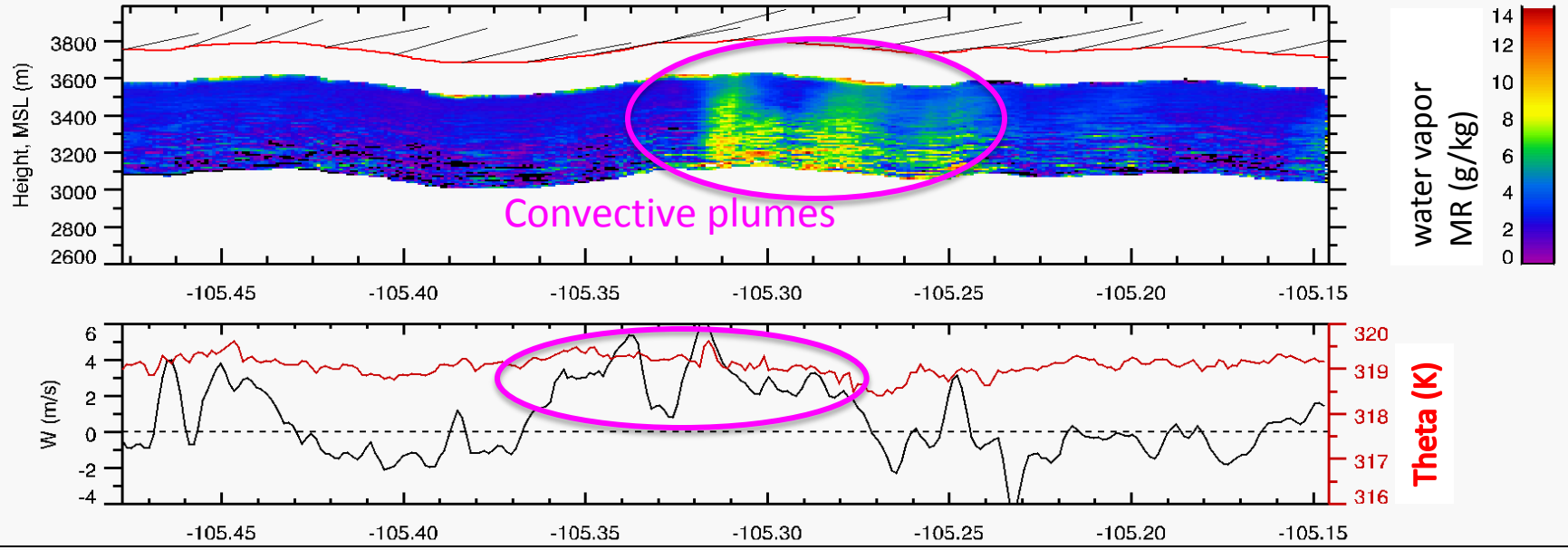



**Fig. 2.** Flight legs and wind vectors centered over SE WY for (a) Leg 1: 2041-2055 UTC, (b) Leg 2: 2109-2116 UTC, (c) Leg 3: 2120-2125 UTC, and (d) Leg 4: 2201-2210 UTC. The topography is shown in the same manner as in Fig. 1 and the flight legs are once again colored by flight-level $q_v$ measurements. Wind vectors are shown as lines with origin on the flight leg (i.e. banners pointing downwind), in length proportional to the wind speed (10 m $s^{-1}$ vector shown at bottom-left for reference). All flight legs were flown at ~500 m AGL (2300-3000 m MSL), with the exception of (c) which was flown at ~1500 m AGL (~3600 m MSL). Base reflectivity from the Cheyenne WSR-88D radar (KCYS, located at the white asterisk) is shown at the closest scan times to when the aircraft flew through or over the strongest humidity gradient. These times are (a) 2043 UTC, (b) 2110 UTC, (c) 2124 UTC, and (d) 2206

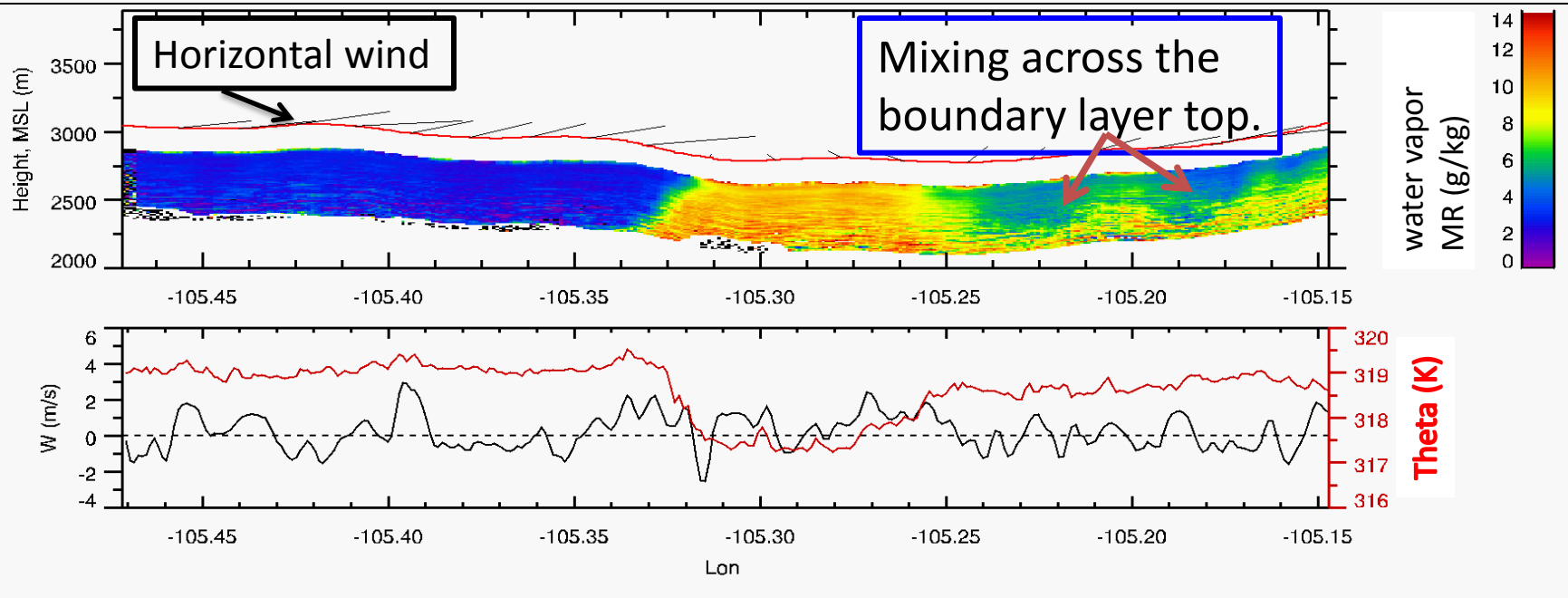
From Bergmaier et al., MWR, in press

# Dry-line Structure from Airborne Raman Lidar

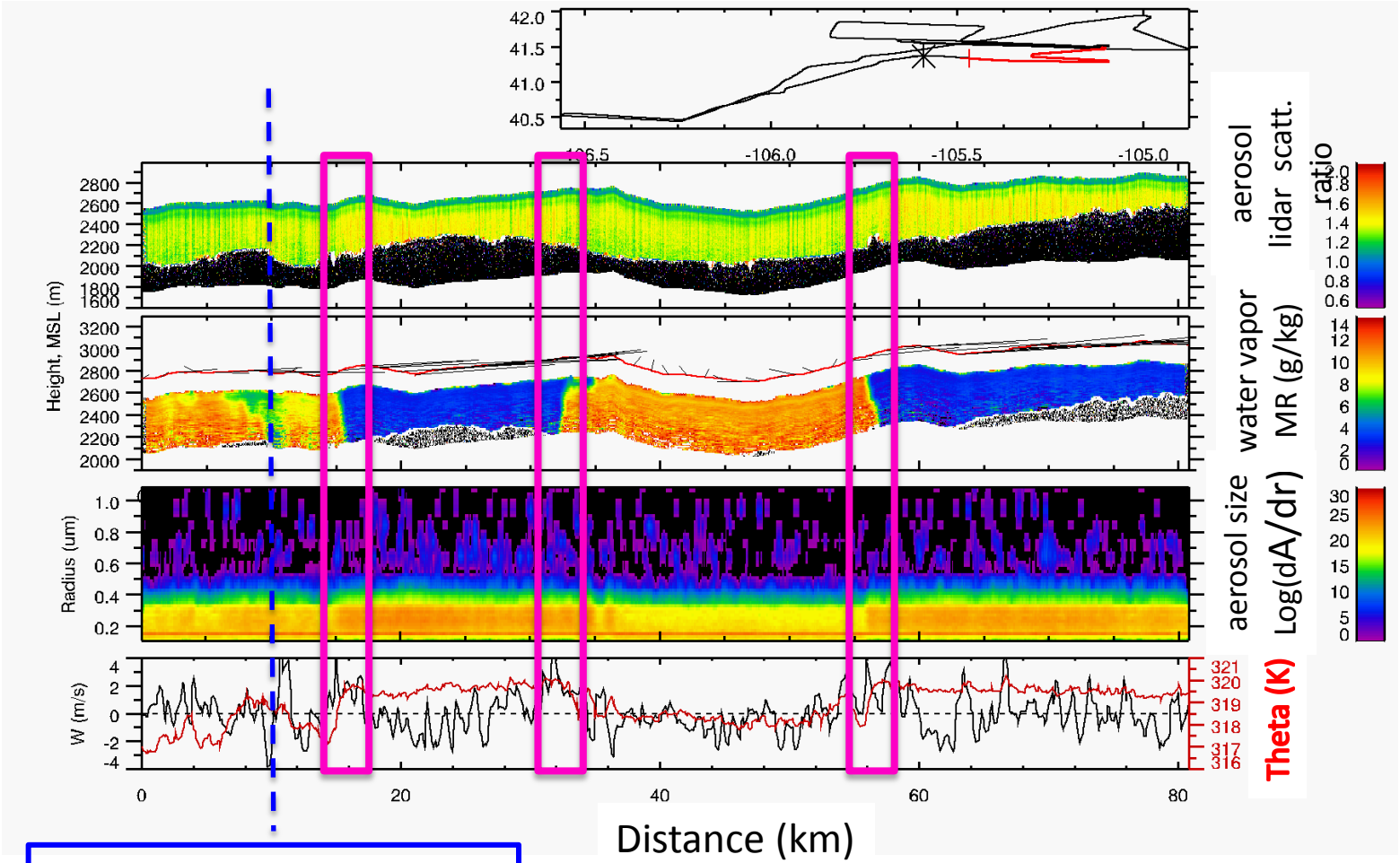
**Leg 1, 3.6km**




**Leg 2, 3km**



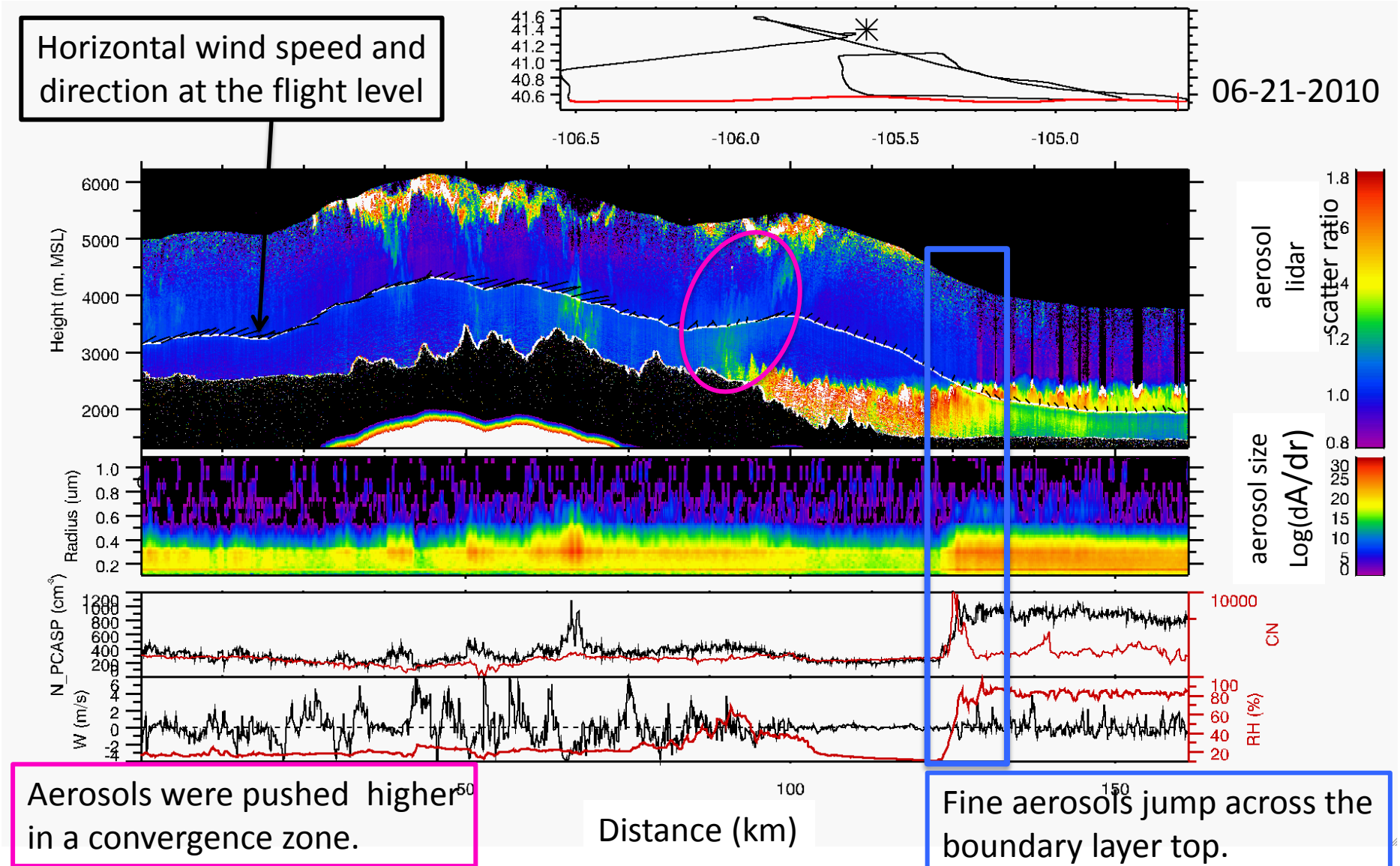
# Spatial Variability



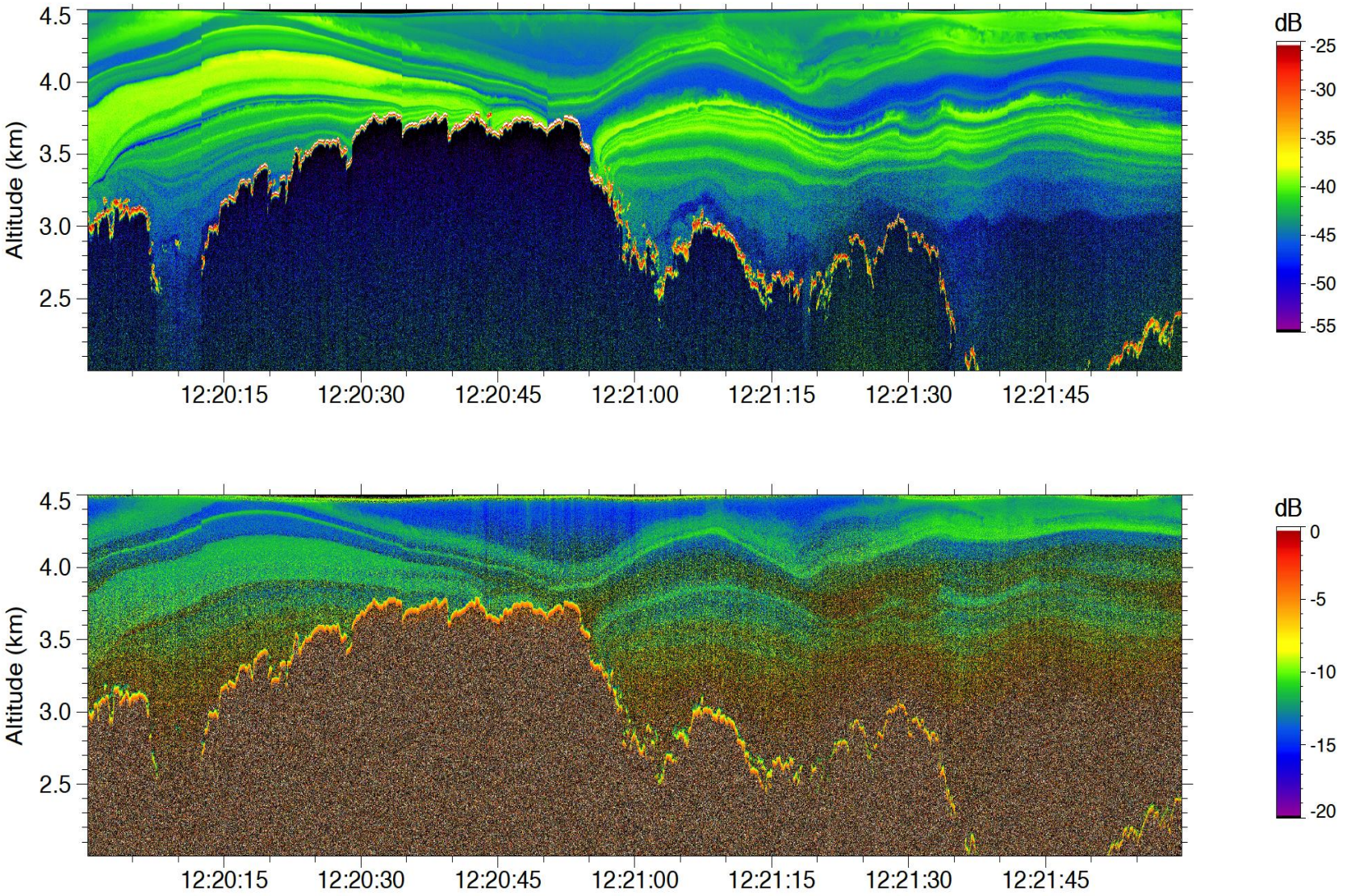

The mixed-parcel goes down to surface!

Three dry line crosses.

# The Aerosol Distribution Across the Rocky Mountains



# Aerosols Over Convection




From Dave Leon