

Multi-functional Airborne Raman Lidar (MARLi) and 5-Beam Airborne Doppler Radar (ADL)

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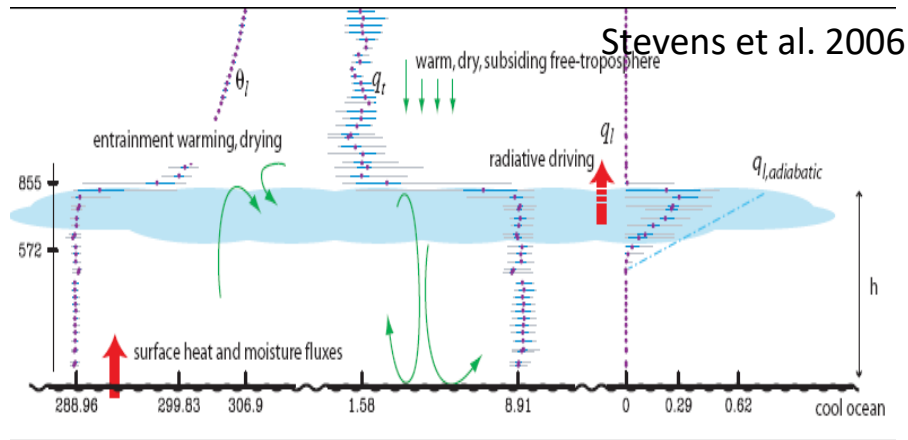
M. Hardesty, J. Lundquist, A. S. Kittelman, J. Kasic, D. Summers, M. Takeda, *University of Colorado, Boulder*

Supported By NSF

(Bradley F. Smull, Nicholas Anderson, and Shree Mishra)

The Needs of Simultaneous PBL Temperature, Water Vapor, and Wind Measurements

Cloud topped PBL



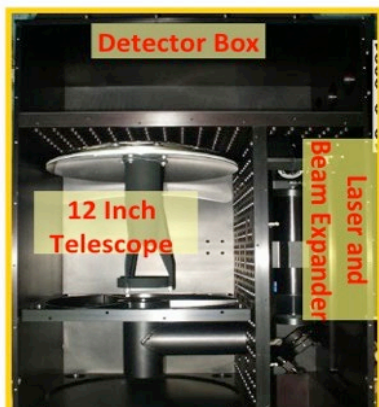
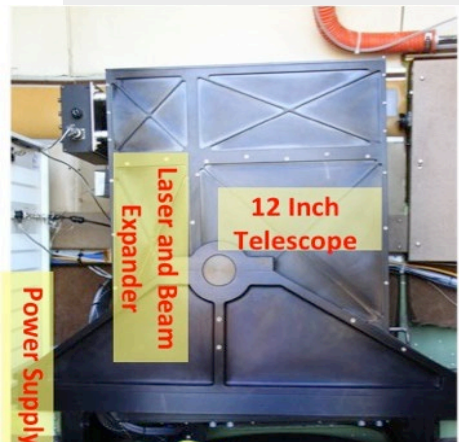
Multi-function Airborne Raman Lidar (MARLi) and Compact Raman Lidar (CRL)

CRL

- Laser: 50 mJ/150 mJ at 30 Hz
- 12-inch telescope
- First flight in 2010

MARLi

- Laser: 220 mJ at 100 Hz
- 16-inch telescope
- First flight in 2016



Simultaneously **water vapor**, **temperature**, and **aerosol** measurements.

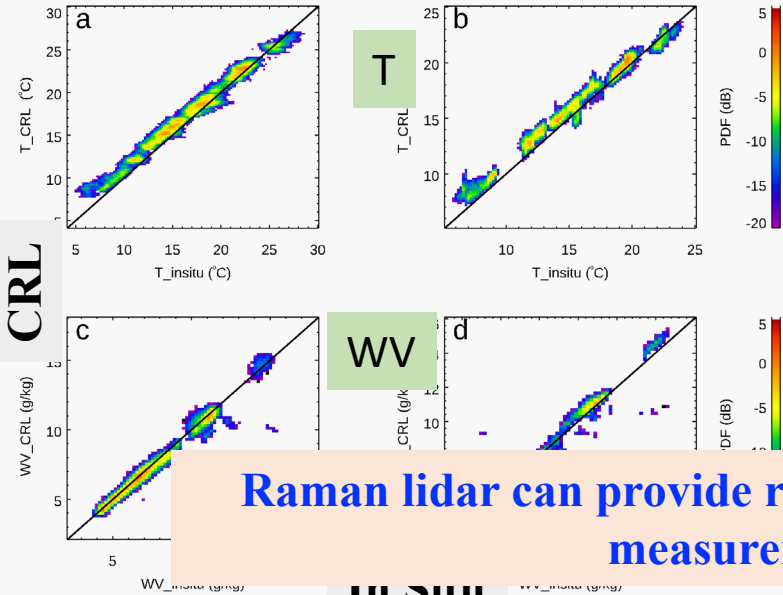
Funded by NSF

Raman Lidar Measurement Validation

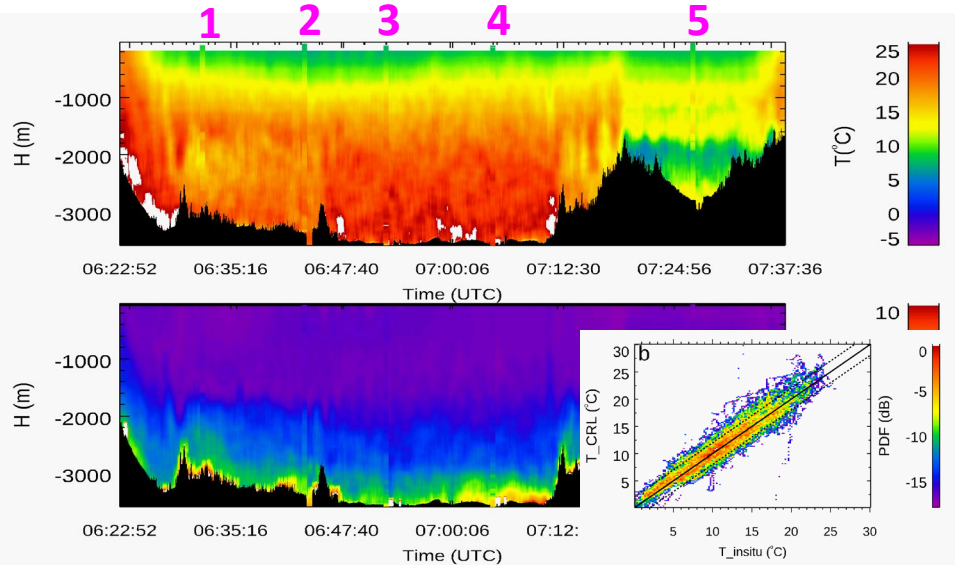
CHEESEHEAD In Situ Measurements

Mean T difference: **-0.7 K**

Mean WV difference: **0.15 g/kg**



SWEX Dropsonde Measurements



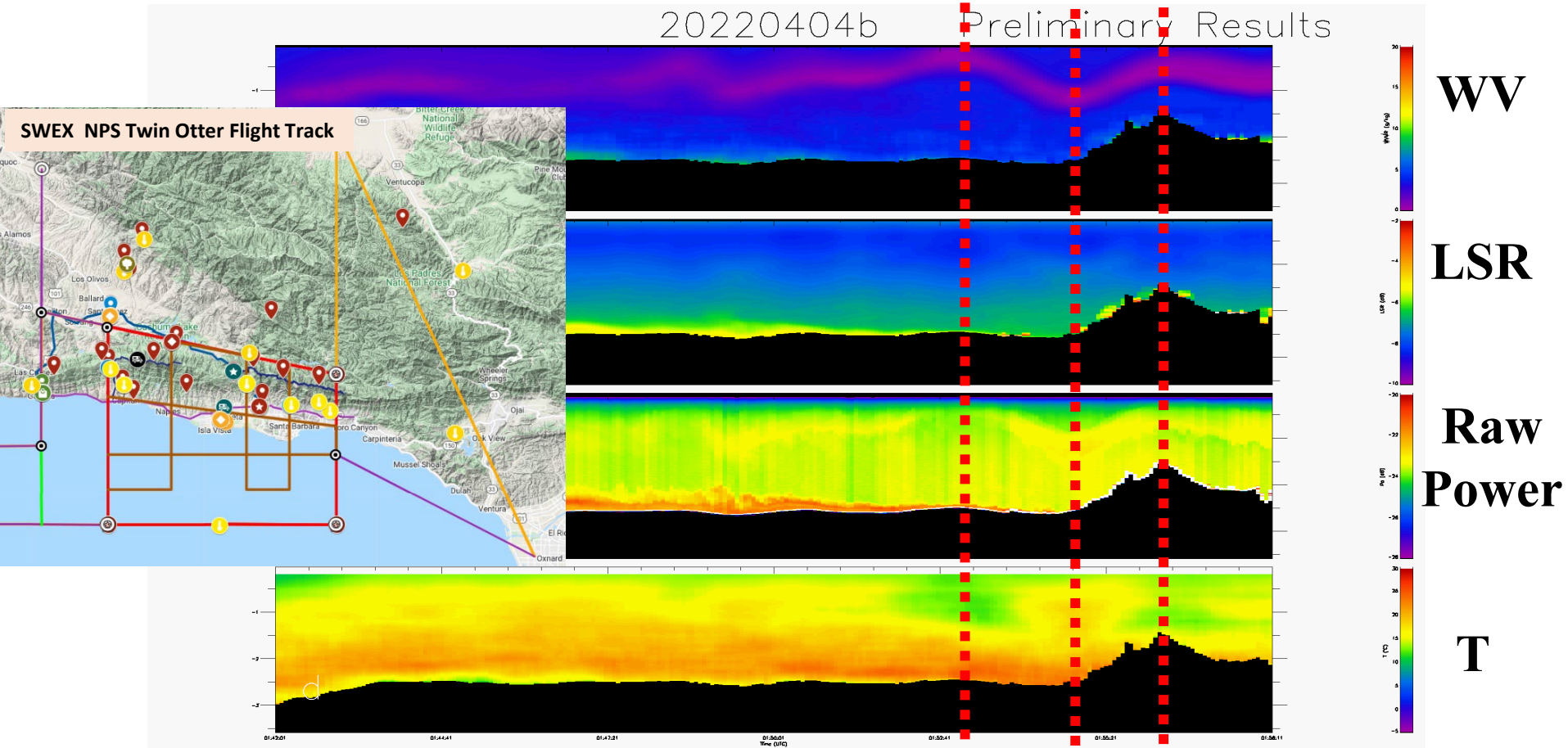
Mean T difference:

Raman lidar can provide reliable water vapor and temperature measurements within PBL!

0.00 g/kg

WV_insitu (g/kg)

Resolving Sub-kilometer PBL Variations

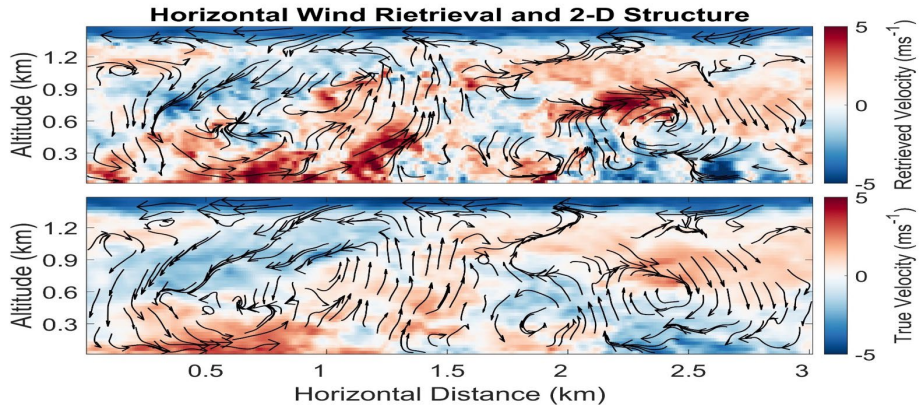
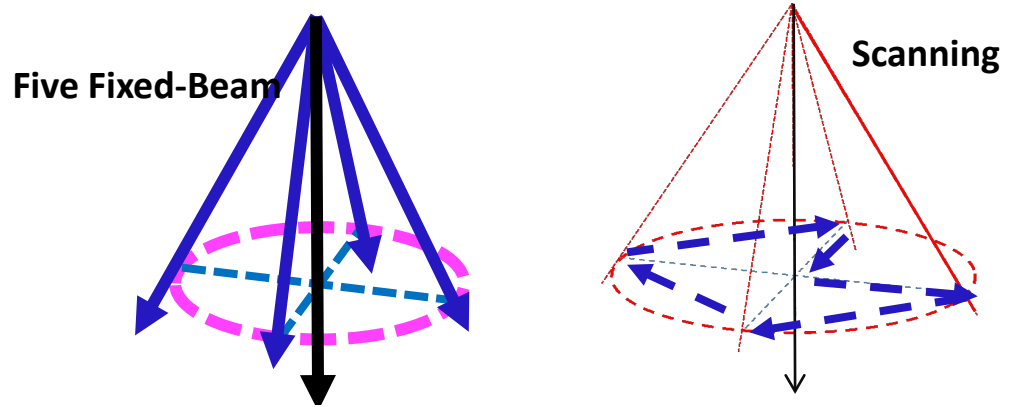


Multi-beam Airborne Doppler Lidar

- Aircraft speed range: 50—160 m/s
- Ground-relative atmospheric wind speed: ± 80 m/s
- Measurement Range: 15 km maximum range (12 km measurable range)
- Along beam resolutions: selectable 18-90m, or mixed at different ranges
- Temporal resolution: 10 Hz and no deadtime between profiles

Data System

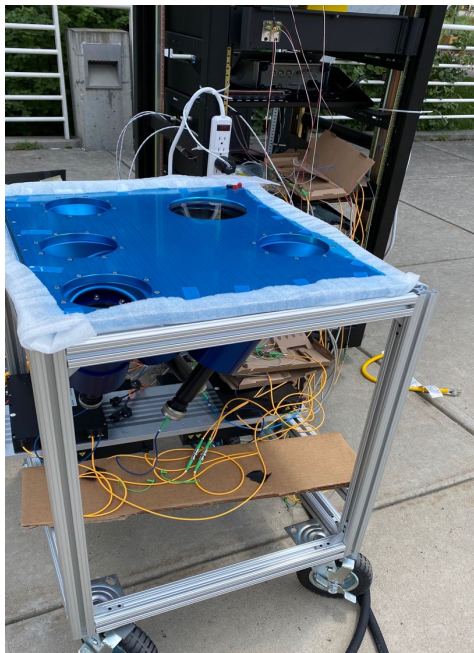
- ❖ Band-width: 30-300 MHz
- ❖ Sampling rate: 1G/s
- ❖ FFTs: 4096 points
- ❖ 200 range gates per profile
- ❖ Keep full power spectrum for post-data analysis



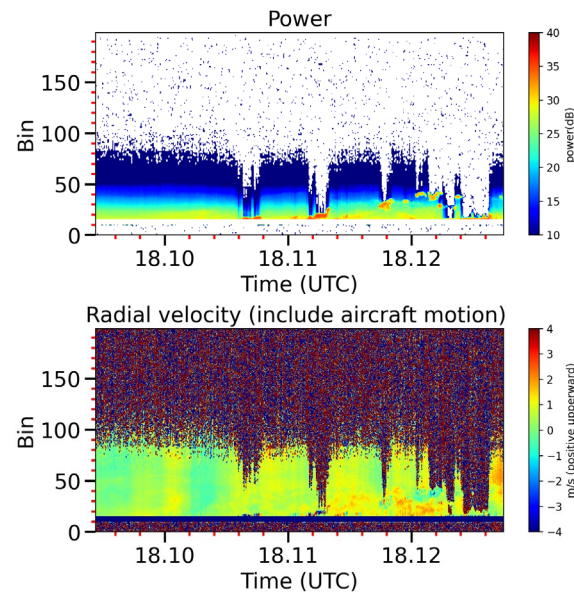
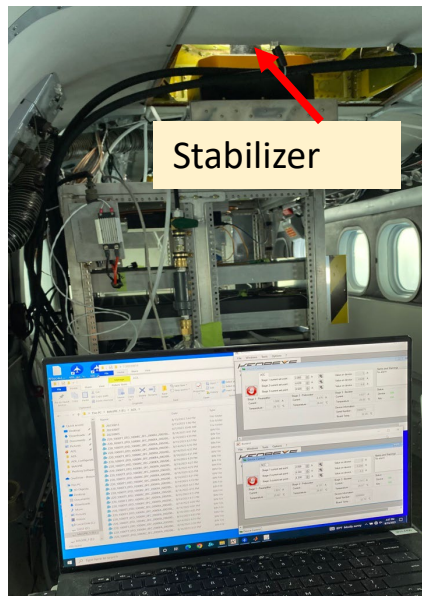
Retrieved using foreword, nadir, and backwards beams at 30deg elevations, flying crosswind in 15 m/s mean wind

ADL Testing

Ground-based Five-beam Testing



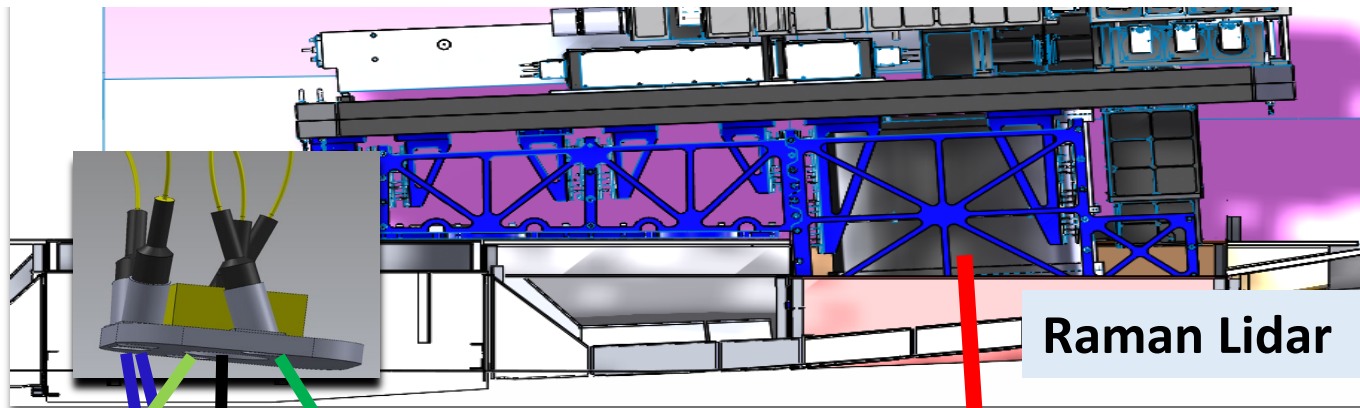
Two-Beam testing on the NPS Twin Otter



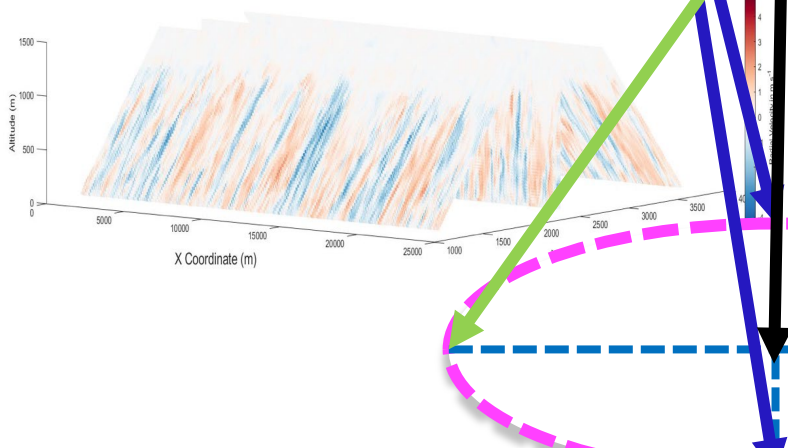
Will be Deployed on NSF/NCAR C-130 for the **CAESAR** and NASA P-3 for the **ARCSIX** in 2024.

Future Wyoming King Air PBL Observations

Five Fixed-beam
Airborne Doppler
Lidar (ADL)



All Radial Measurements



Wind and
Turbulence
profiling

Water vapor,
temperature,
and aerosol
profiling

➤ Also available on **NSF/NCAR C-130 and G-V** and **van-based mobile** operations.