Recent NOAA Wind and Water Vapor Lidar Activities

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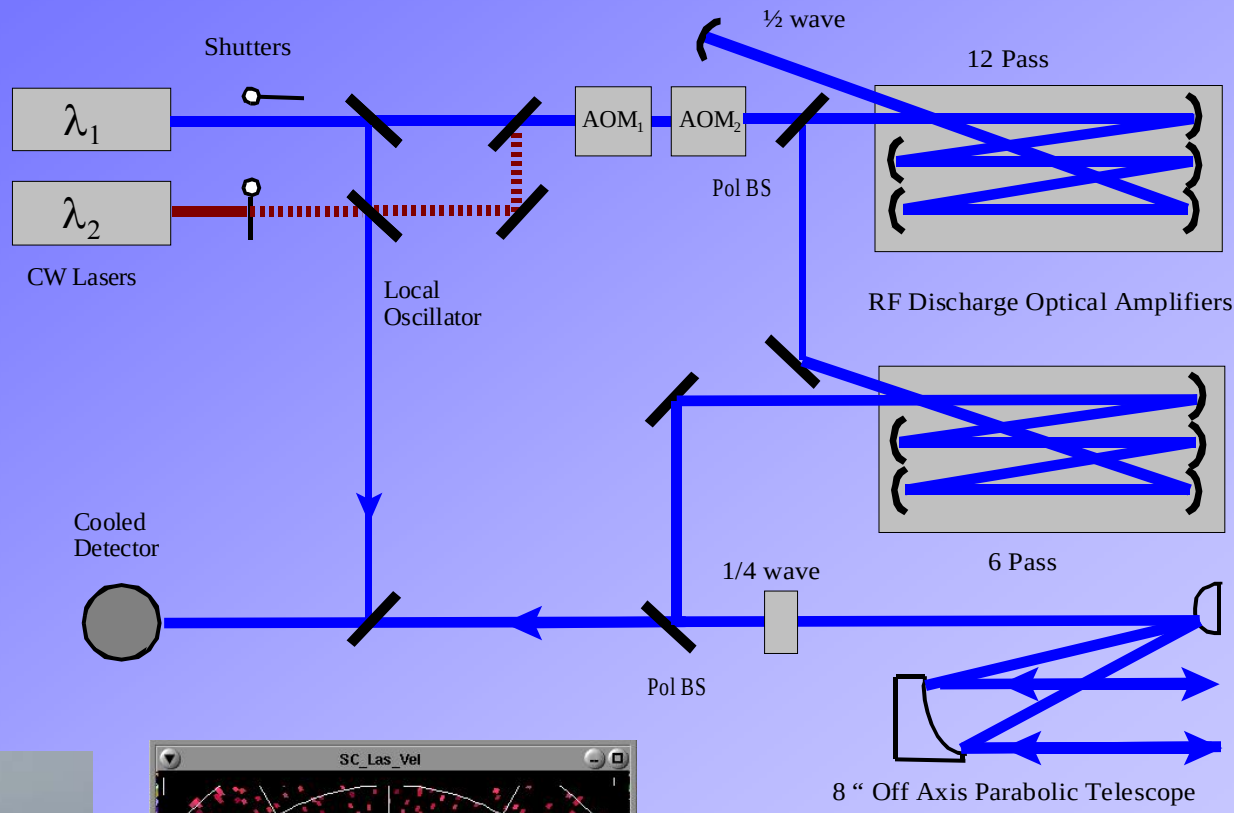
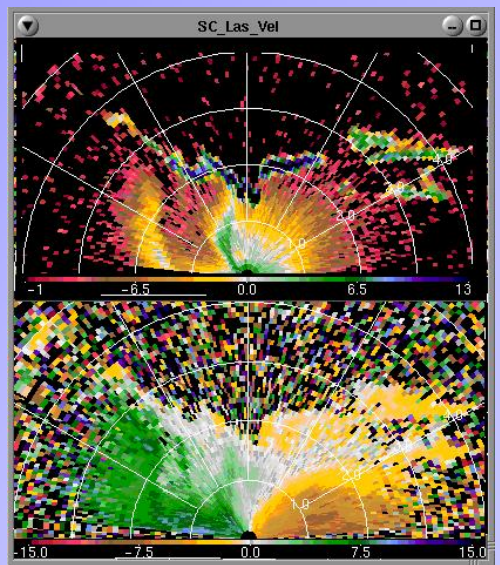
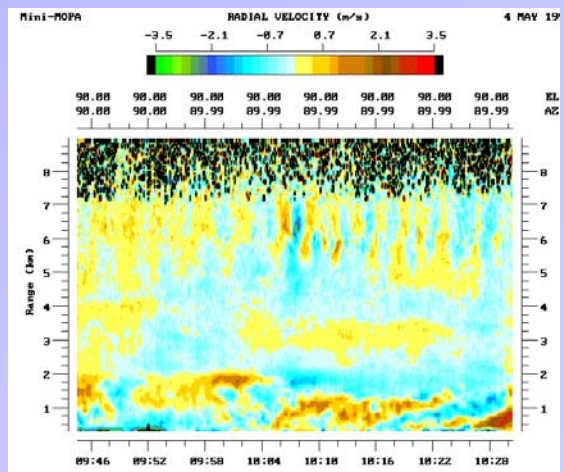
Mini-MOPA Doppler Lidar

Wavelength	**9-11 micron**
Pulse Energy	**2 mJ**
PRF	**300 Hz**
Max Range	**18 km**
Range Resolution	**45-300 m**
Scanning	**Full Hemispheric**
Precision	**10 cm/s**



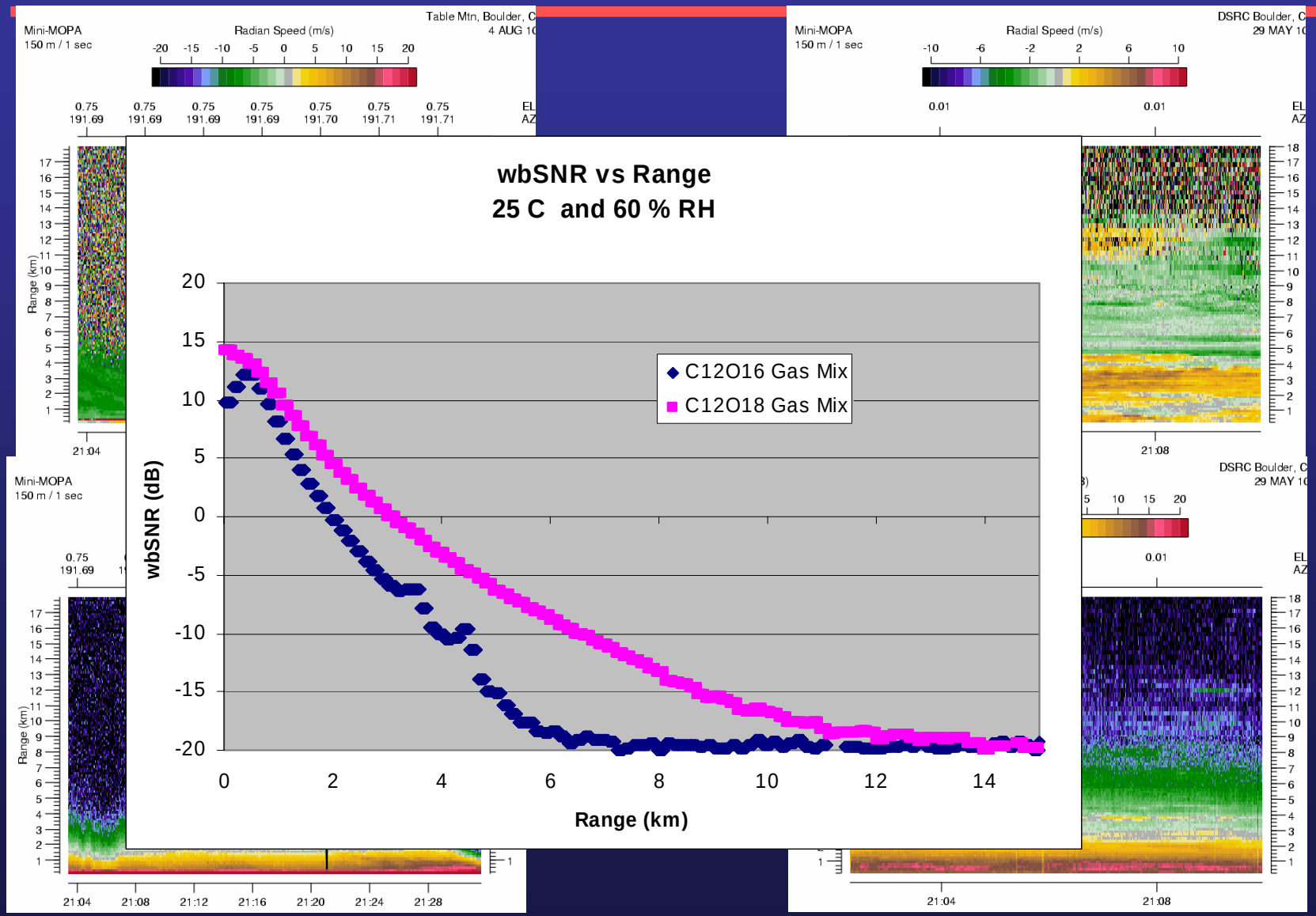




Recent development

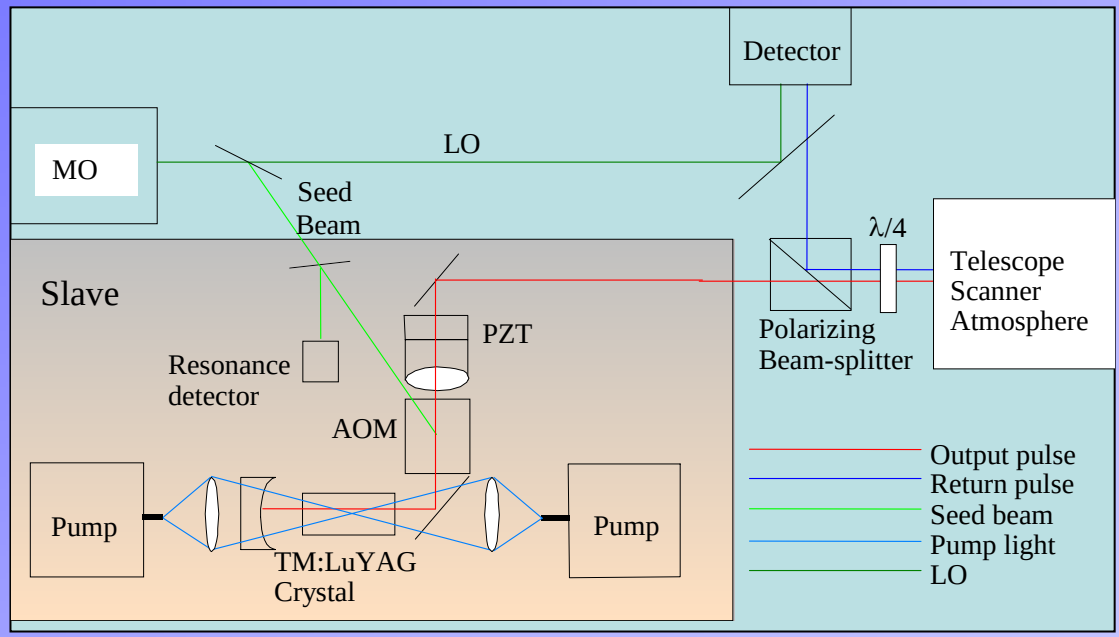
- Dominant atmospheric absorption
  - Water vapor
  - Carbon dioxide
- Operate instrument on rare isotope $C^{12}O^{18}{}_2$
  - Moves wavelength from 10.6 to 9.3 microns
  - Decrease atmospheric absorption
    - Reduce continuum water vapor absorption
    - Eliminate CO_2 absorption
  - Increase backscatter from ammonium sulfate (up to X10)
  - Increase output power by a factor of 3
- Yields near doubling of range

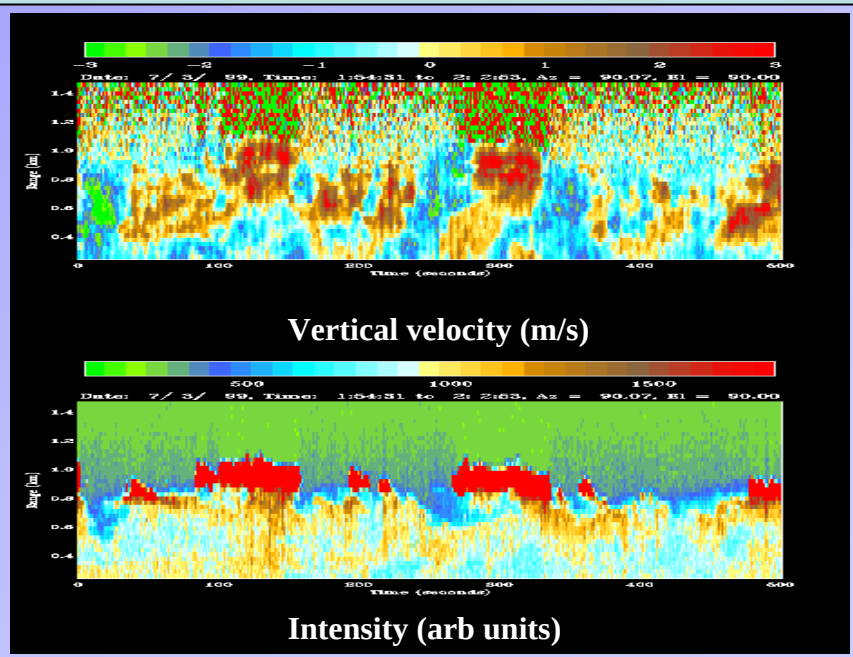
Impact of CO^{18}_2 Isotope Gas Mix



High Resolution Doppler Lidar (HRDL)

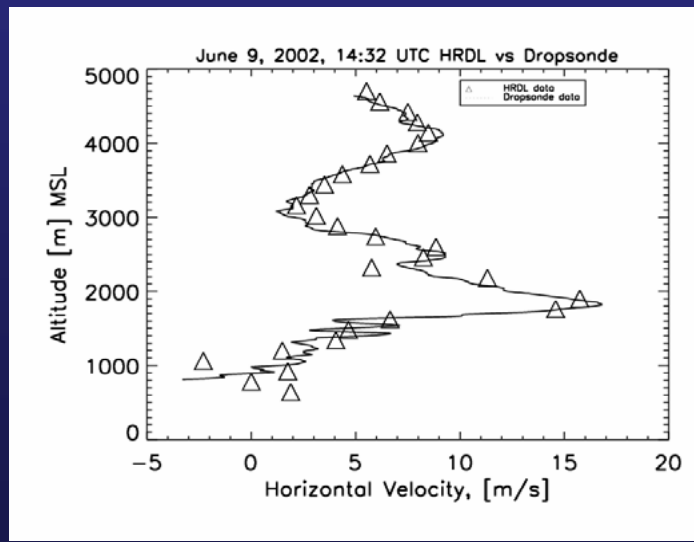
Wavelength	2.02 micron
Pulse Energy	2 mJ
PRF	200 Hz
Max Range	3-8 km
Range Resolution	30 m
Scanning	Full Hemispheric
Precision	10 cm/s



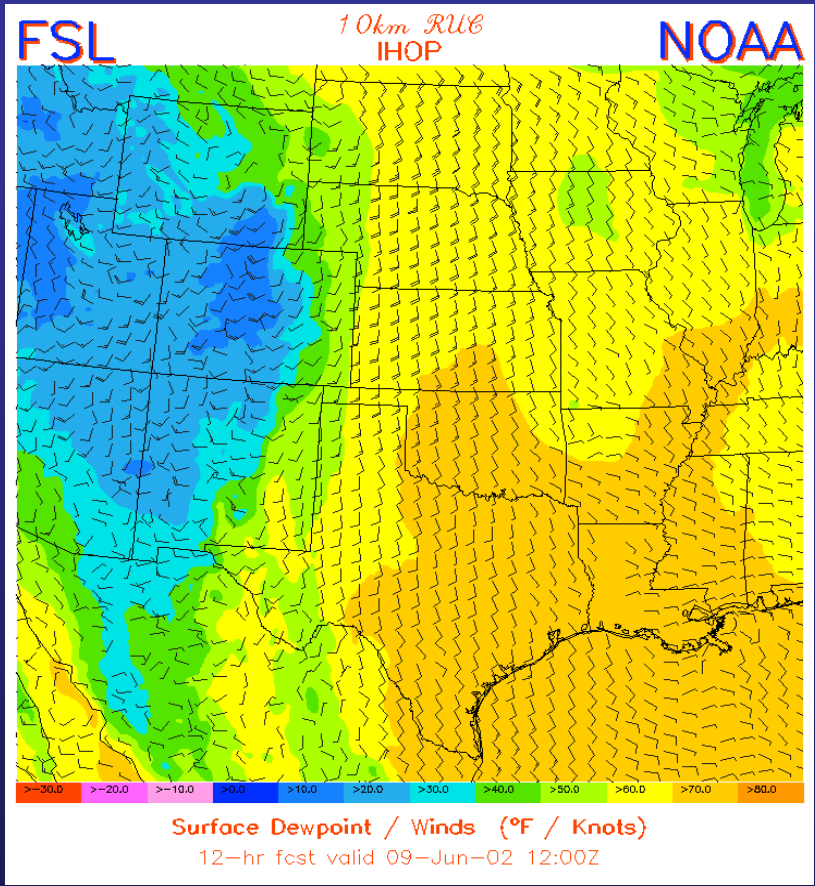


IHOP: Regional Transport of Moisture

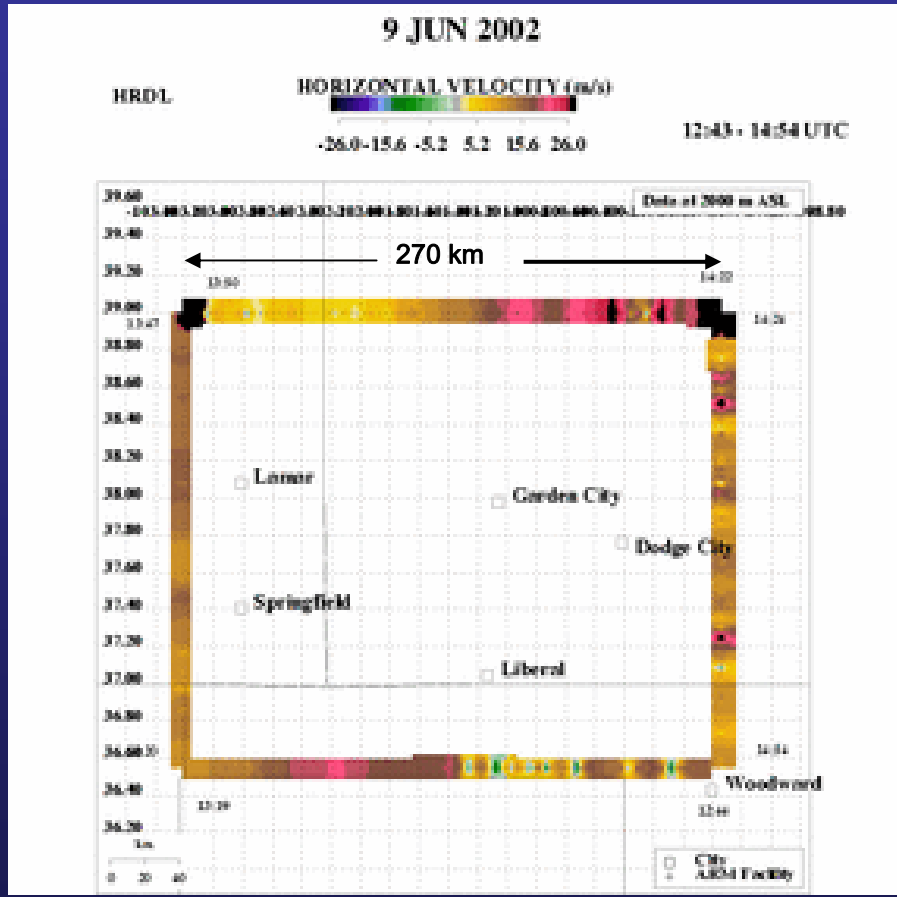
- Co-deployed a Water Vapor DIAL (DLR) and a Coherent Doppler Lidar (ETL) on the DLR Falcon
- Combined measurements to estimate vertical flux profiles and horizontal transport of moisture



IHOP Horizontal Winds: 9 June

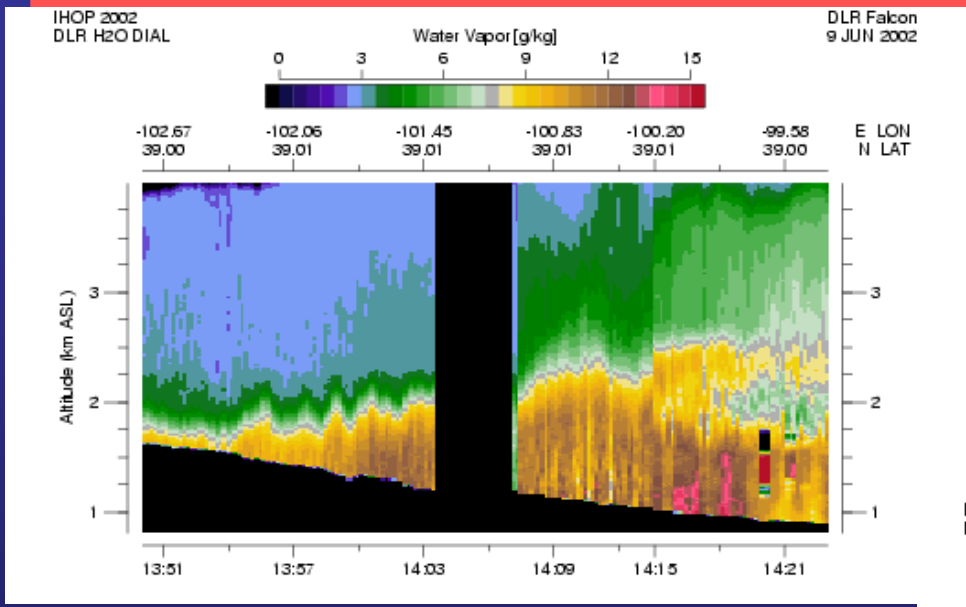


Forecast showed low level jet



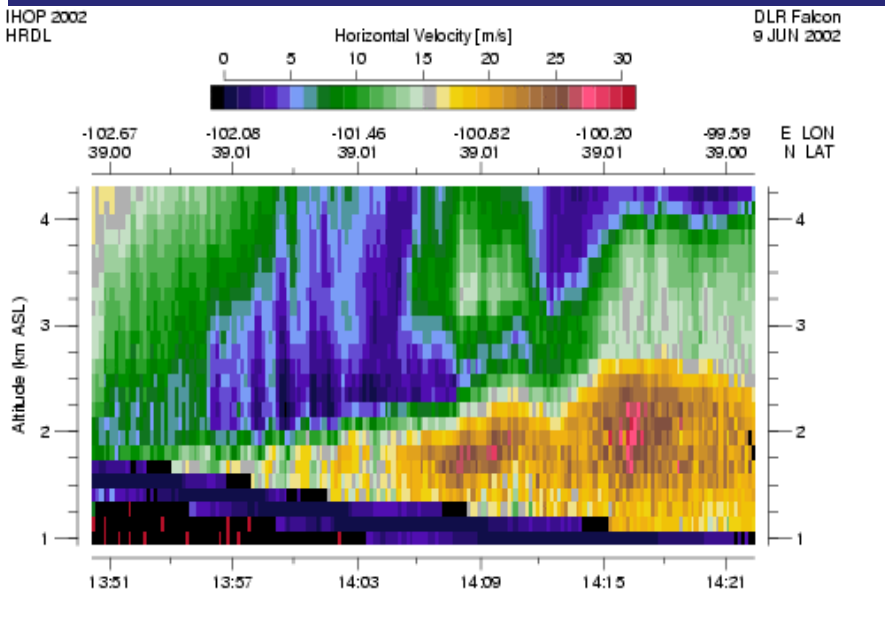
Flight track to measure jet

Northern leg wind and water vapor



Water vapor profiles

Wind Profiles

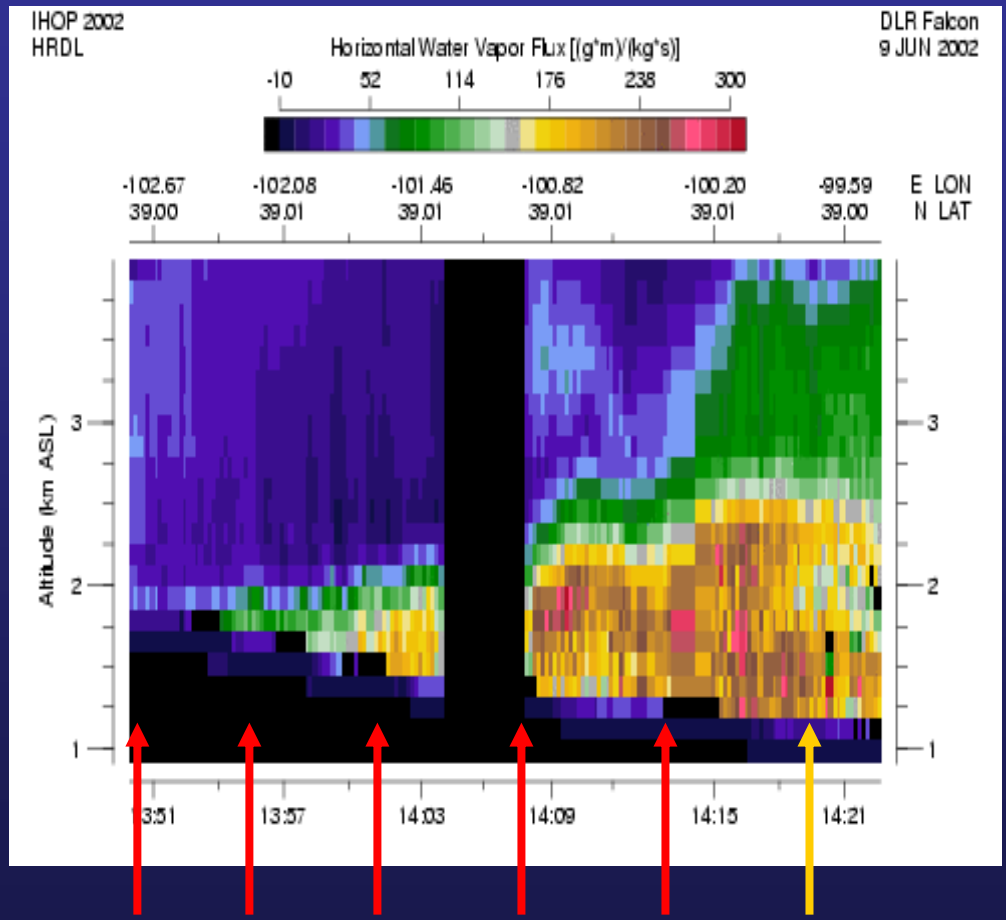


Resolution = 150 m (vertical)

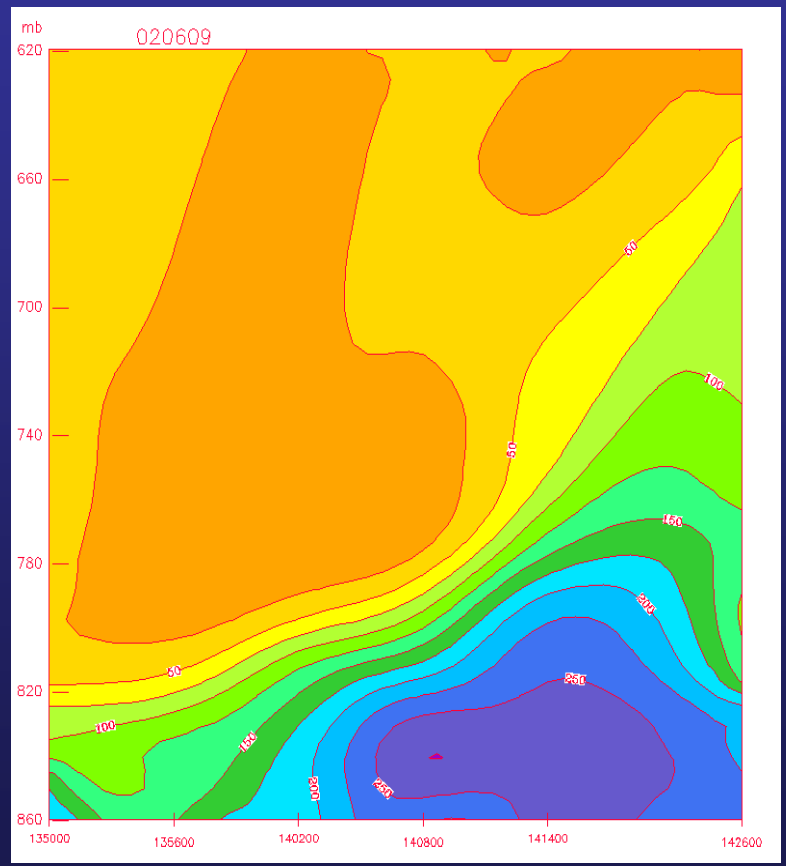
= 1.5 km (horizontal)

Lidar and dropsonde flux comparison

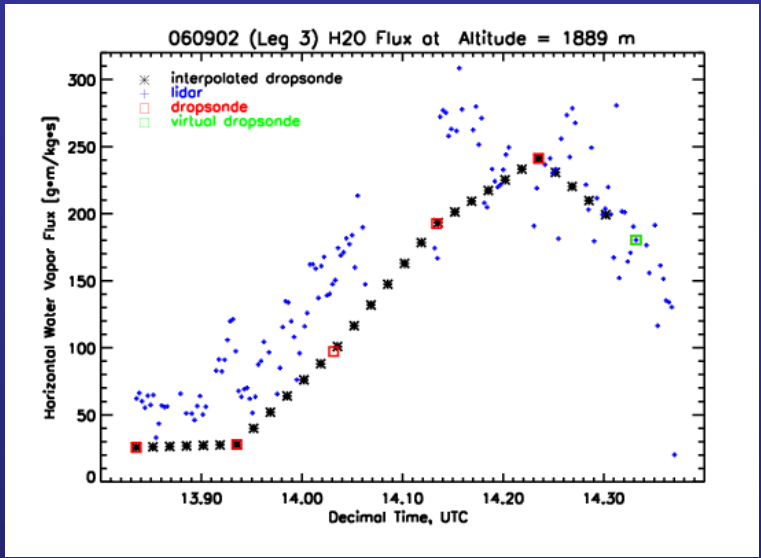
DIAL/Doppler lidar (1500 m spacing)

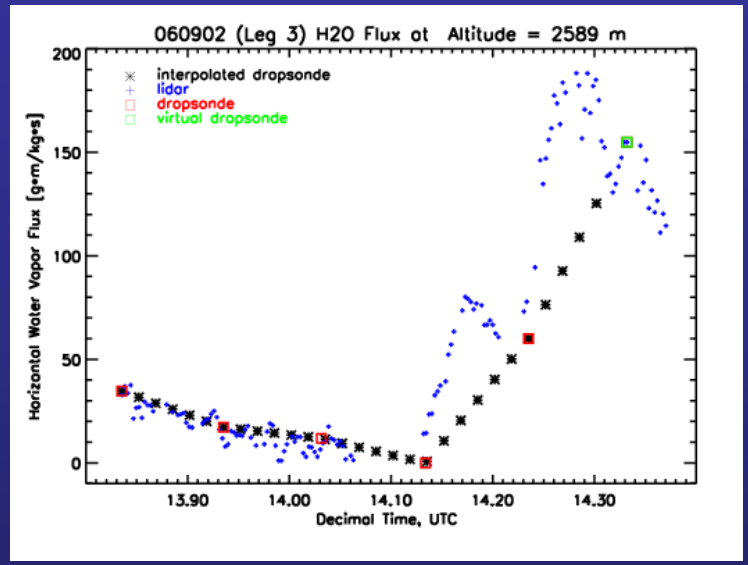


Dropsonde (~50 km spacing)

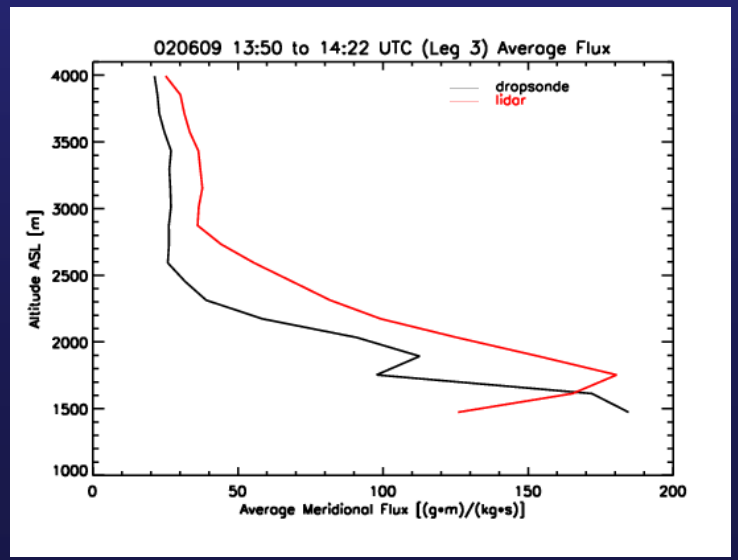


Dropsonde/Lidar Fine Scale Transport

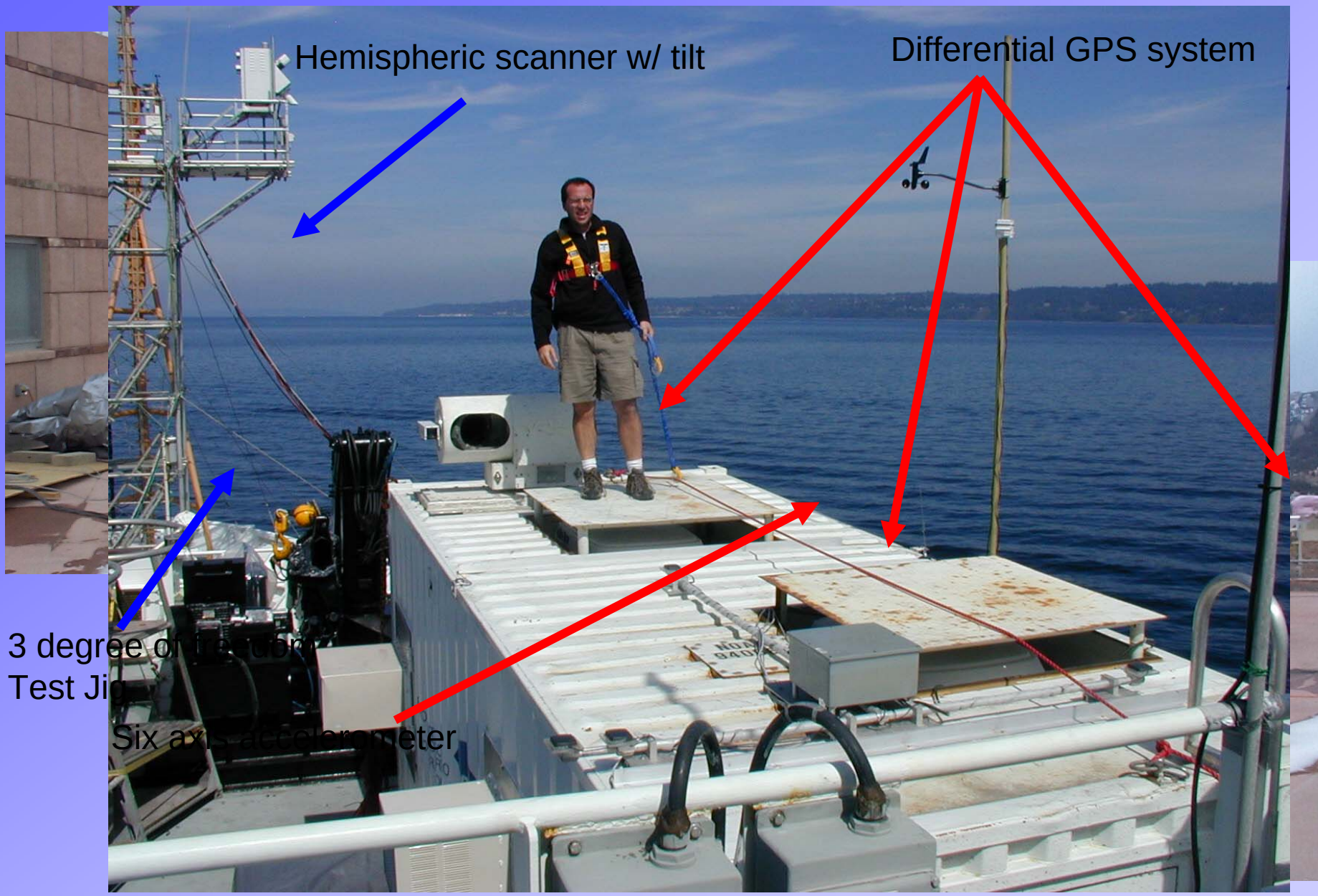




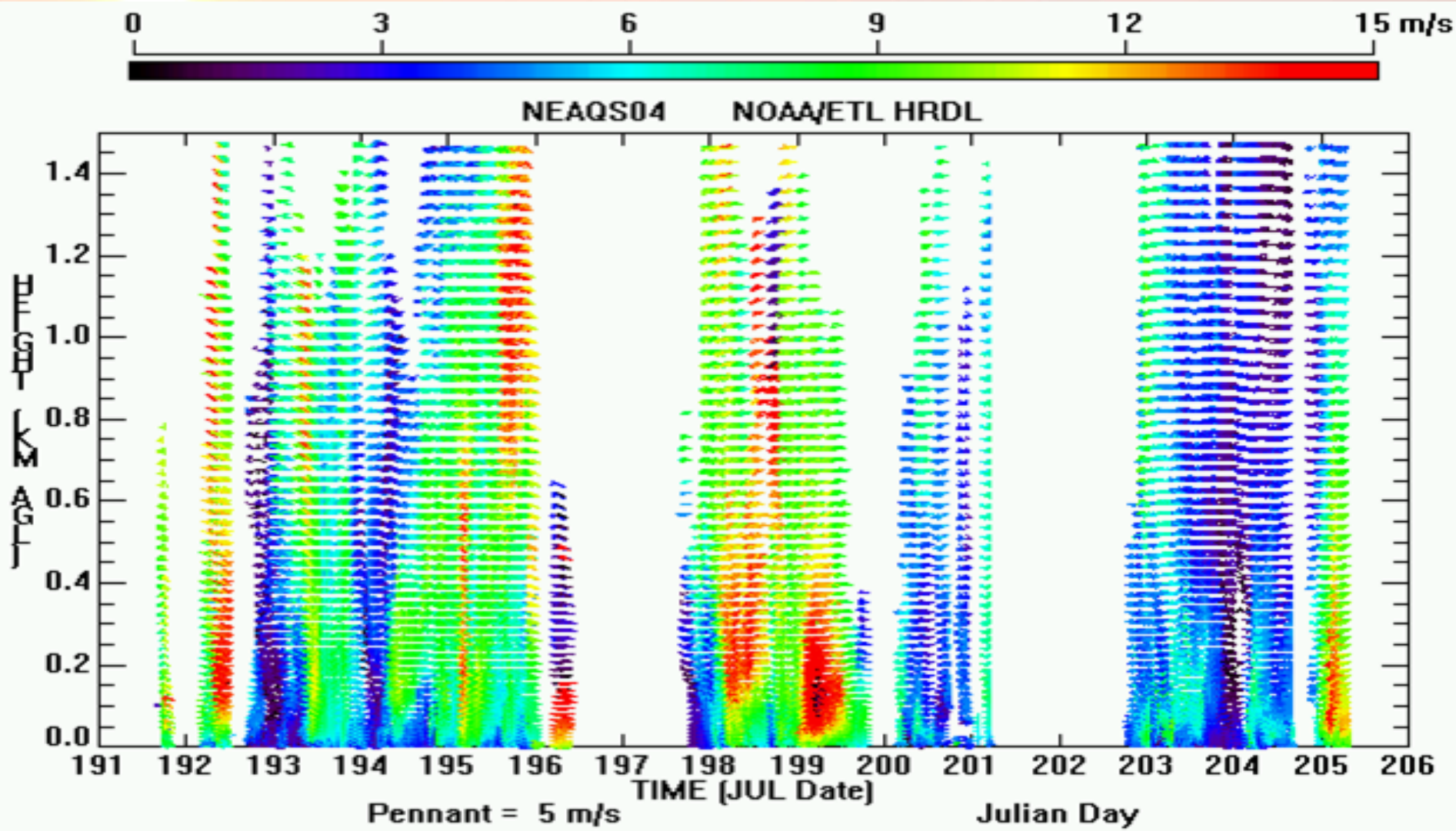
Lidar shows two main “lobes” of high transport missed by the dropsondes above 2000 m ASL



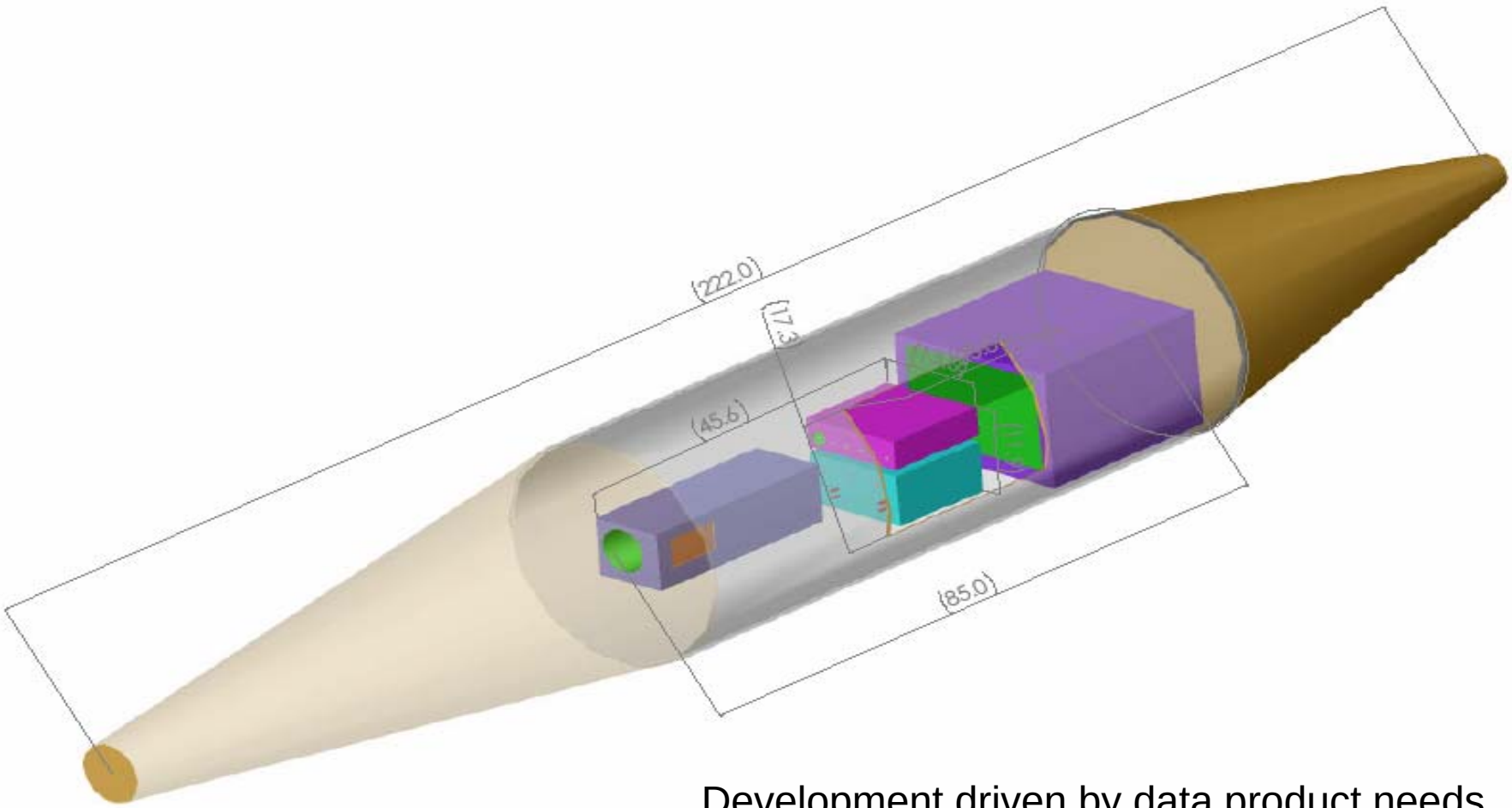
Motion Compensation



HRDL Winds July 11 – July 23 2004 at Sea



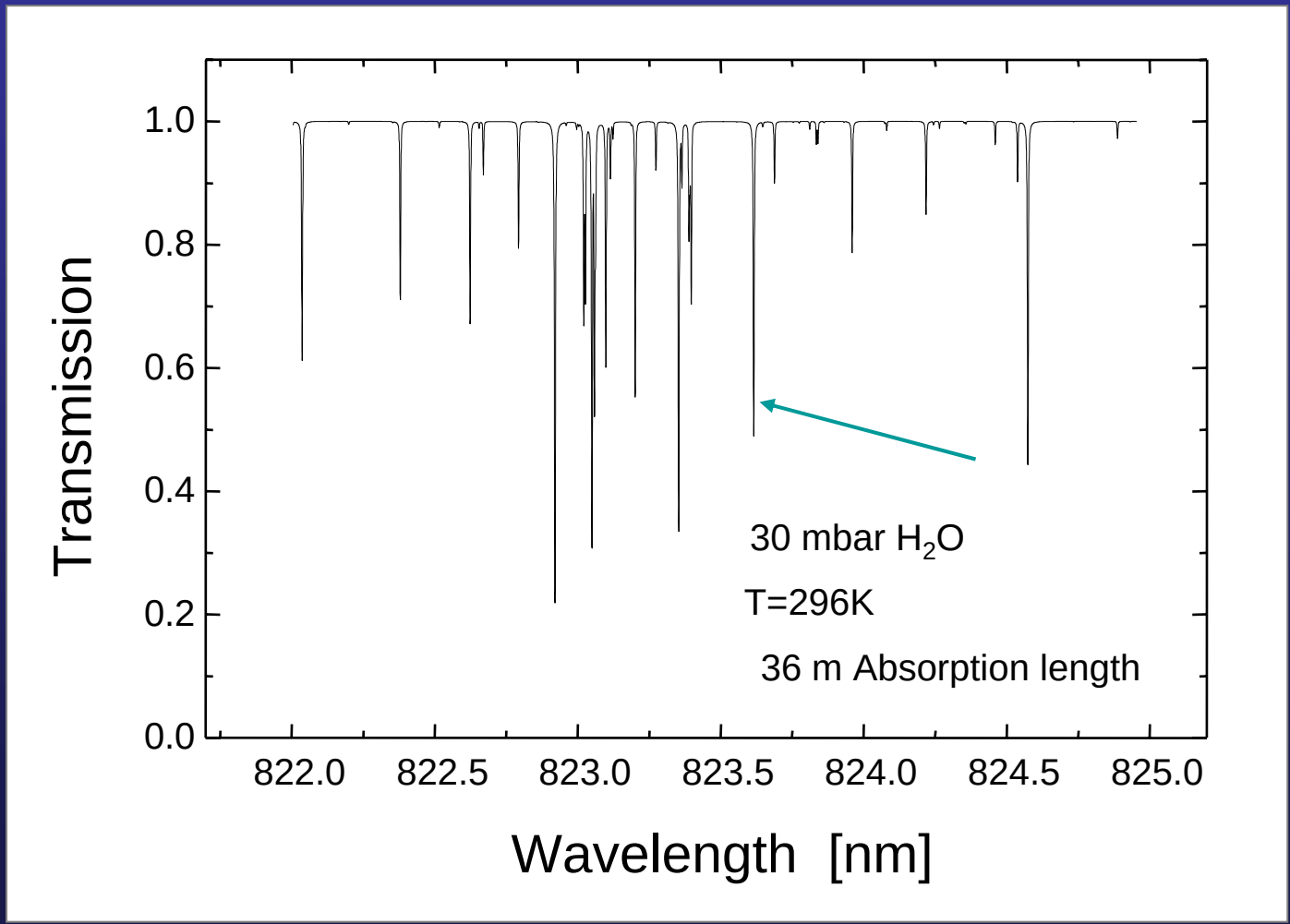
Future : HRDL repackaging



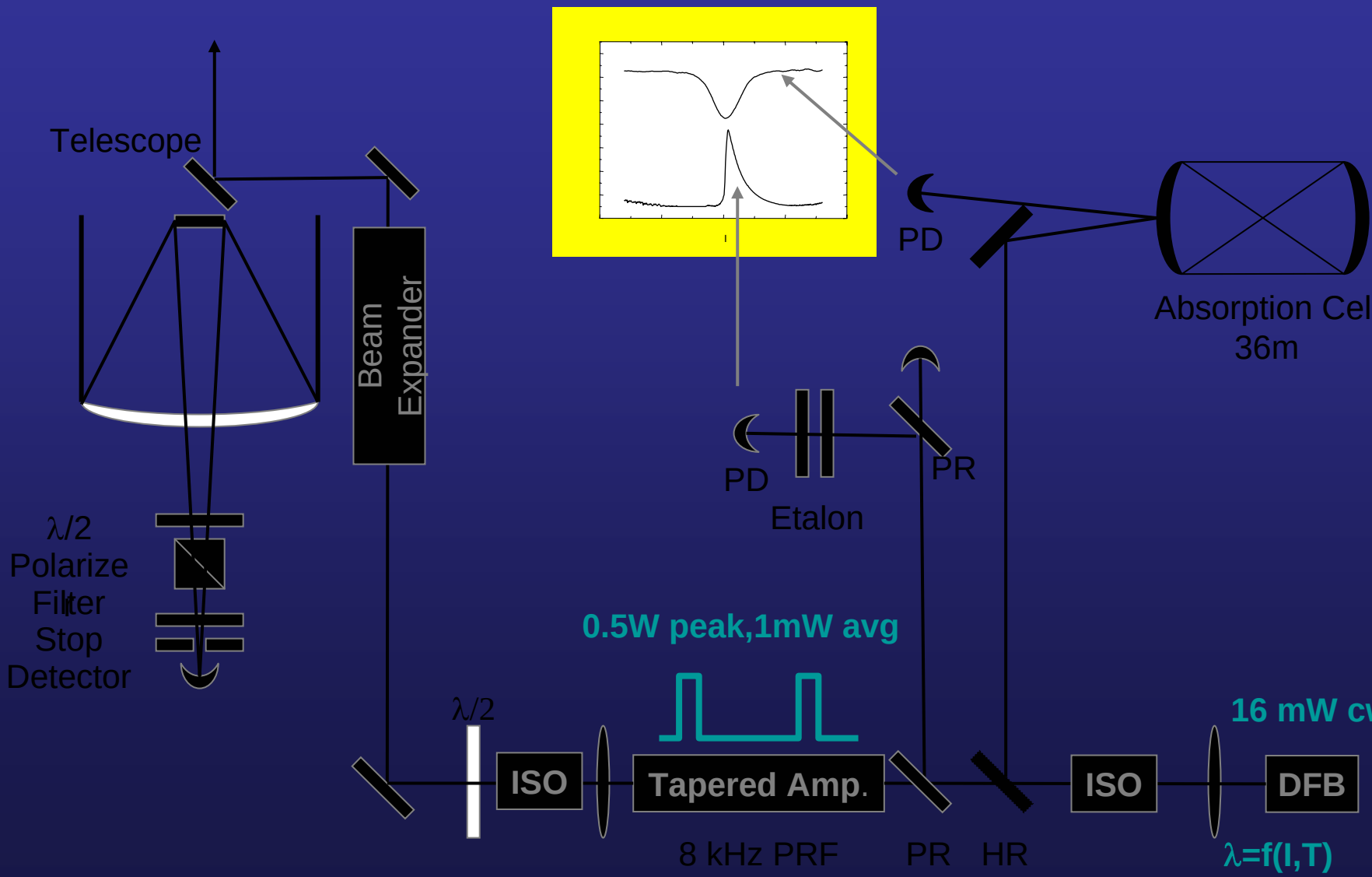
Development driven by data product needs and platform requirements

CODI Unattended Boundary Layer Water Vapor Profiler

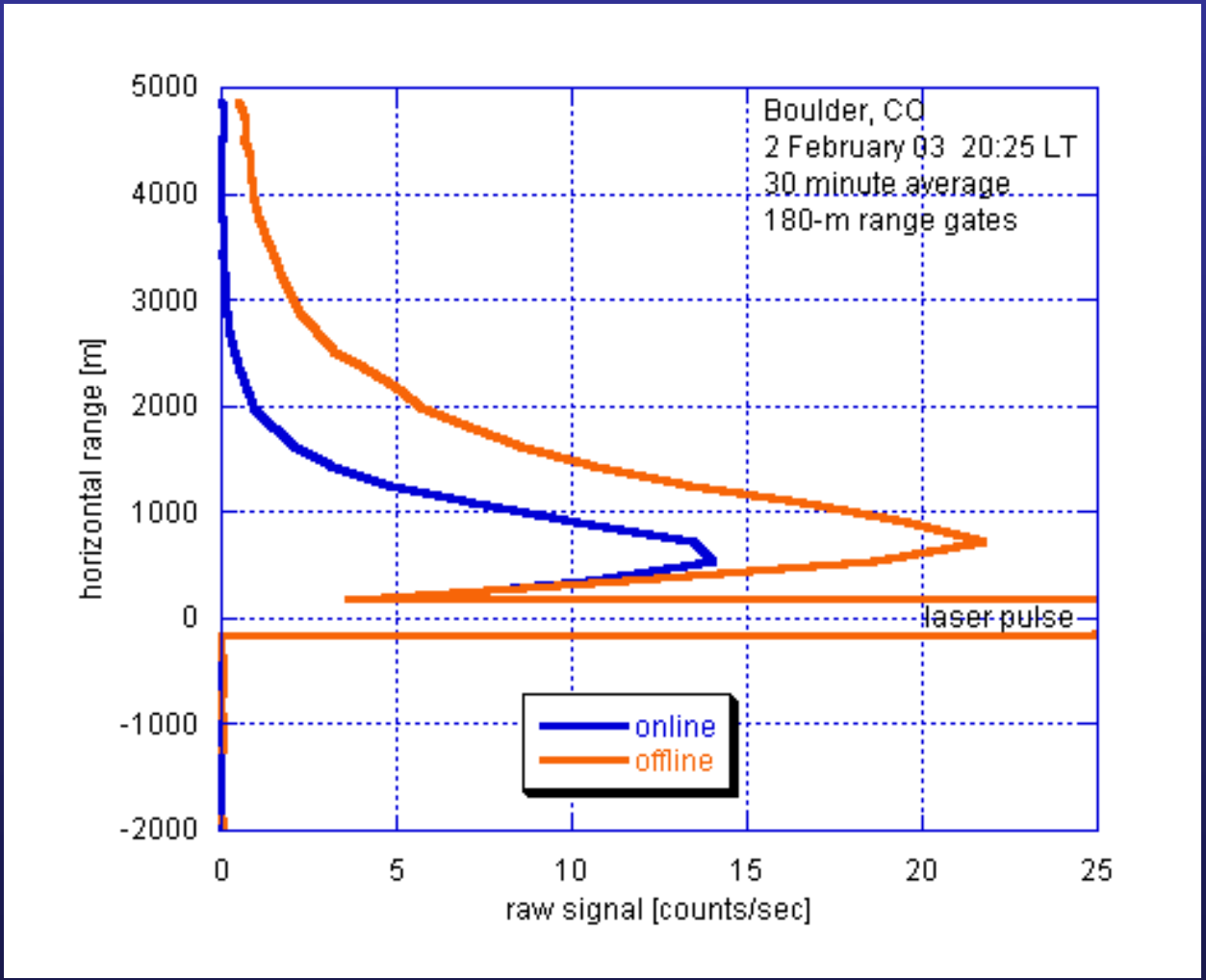
Water Vapor absorption around 825nm



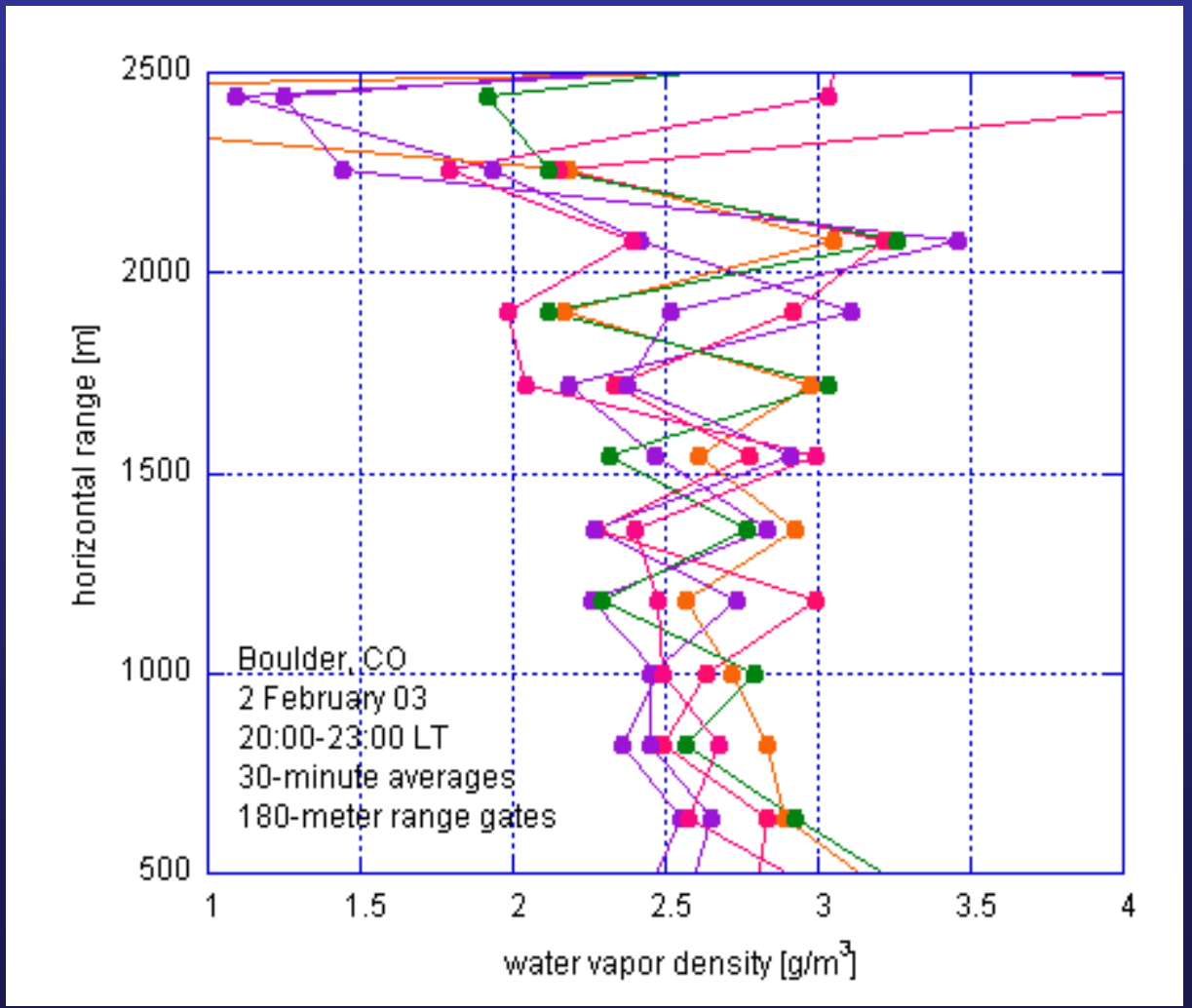
H_2O-Lidar: Optical Set-up



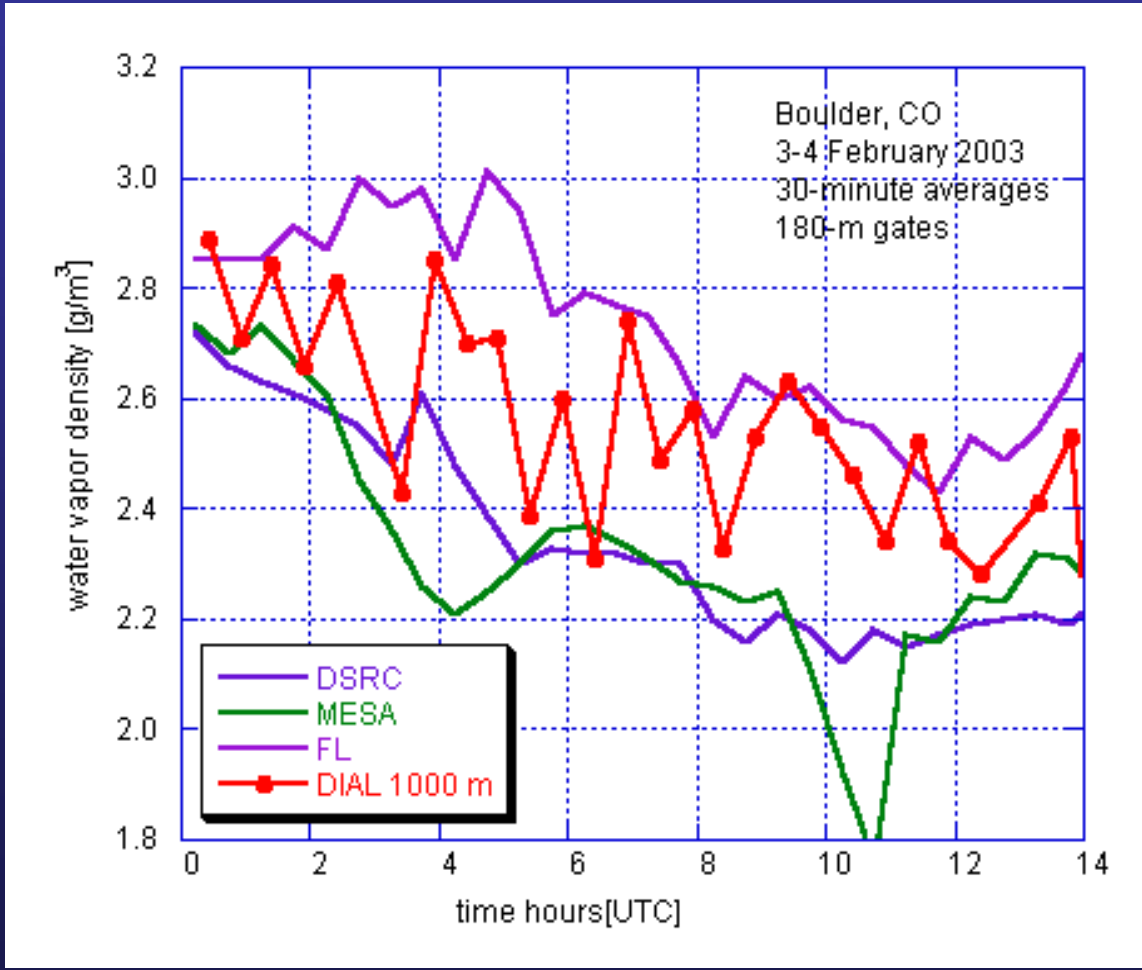
On- and Off-Line Atmospheric Returns

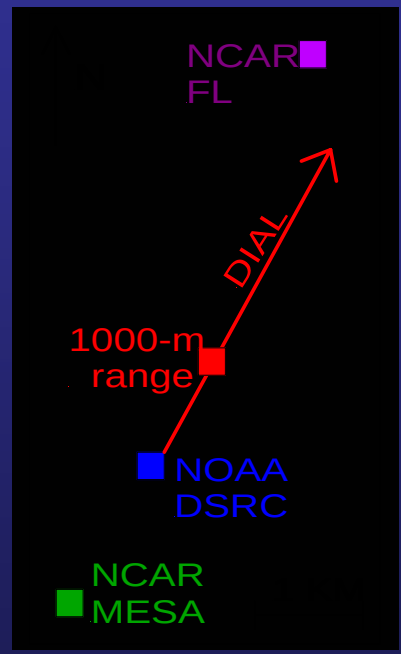


Horizontal Water Vapor Profiles

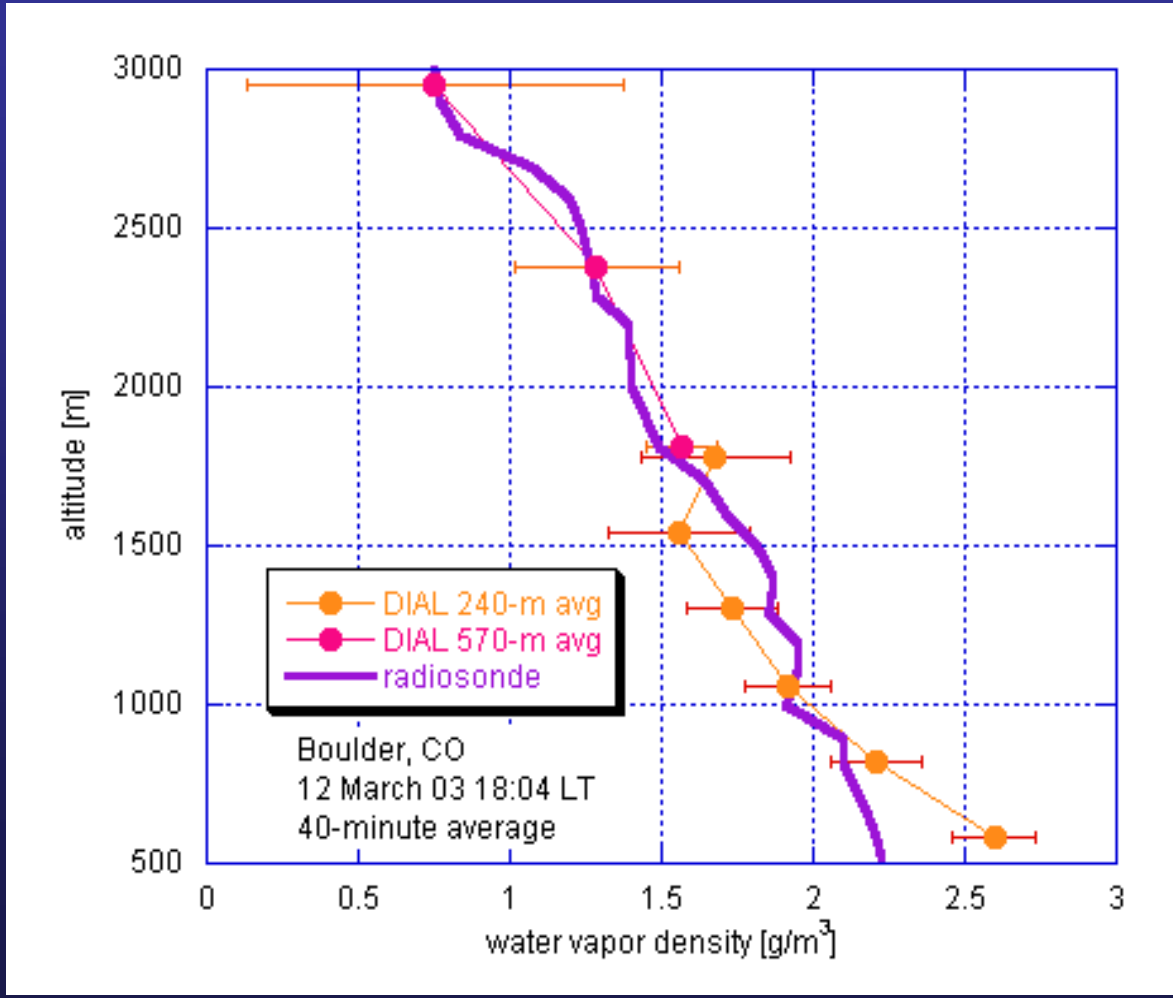


Comparison of horizontal DIAL at 1000 m with *in situ* Sensors



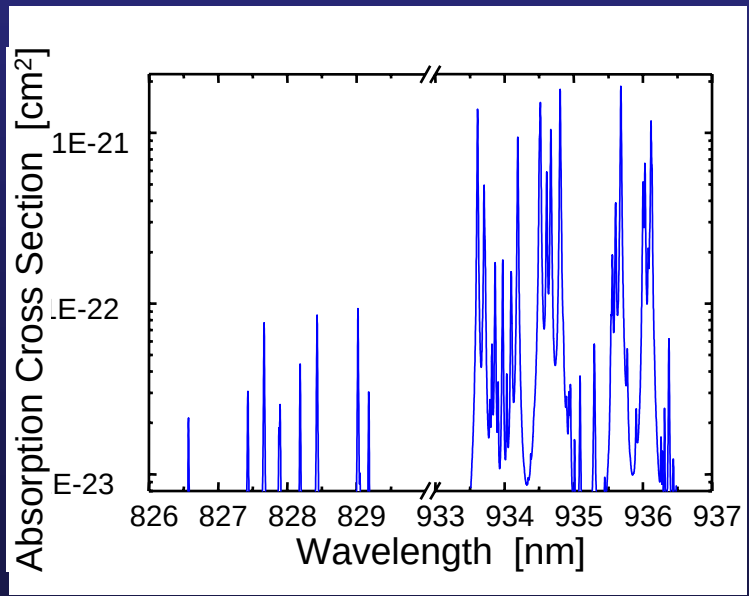


Comparison of vertical DIAL and radiosonde



Desired System Improvements

- Fiber amplifier – more power
- Etalon – more background rejection
- Switches – increased duty cycle
- Air conditioners
- Near-field channel



Potential Capabilities of Upgraded System

conditions	required SNR improvement for ±15% error to 2 km	predicted SNR improvement with new design
night	2	2.8
day - no clouds	7	26
day – dark clouds	20	26
day – bright clouds	>25	26

Summary

- NOAA/ETL has significant experience in Doppler lidar from surface, airborne, ship platforms
- Recent work aimed at stable layers, flows in complex terrain, marine layer measurements, and transport of atmospheric species
- New water vapor lidar demonstrated potential for long term, continuous measurements, but needs upgrades to transmitter and receiver for 24 hour operation