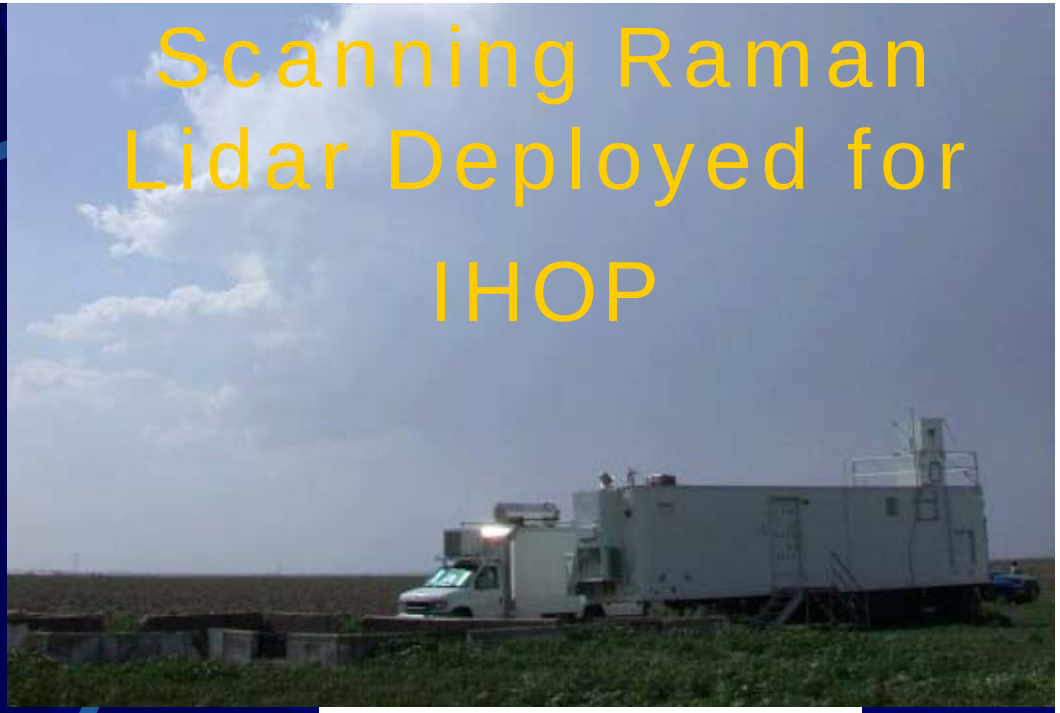
NASA/GSFC Raman Lidar Instrumentation Available for COPS

David Whiteman, Belay Demoz, NASA/GSFC
Zhien Wang, UMBC
Paolo Di Girolamo, Univ. of Basillicata
Eugenia Kalnay, Univ. of Maryland
Zhao Xia Pu, Univ. of Utah
Volker Wulfmeyer, Univ. of Hohenheim

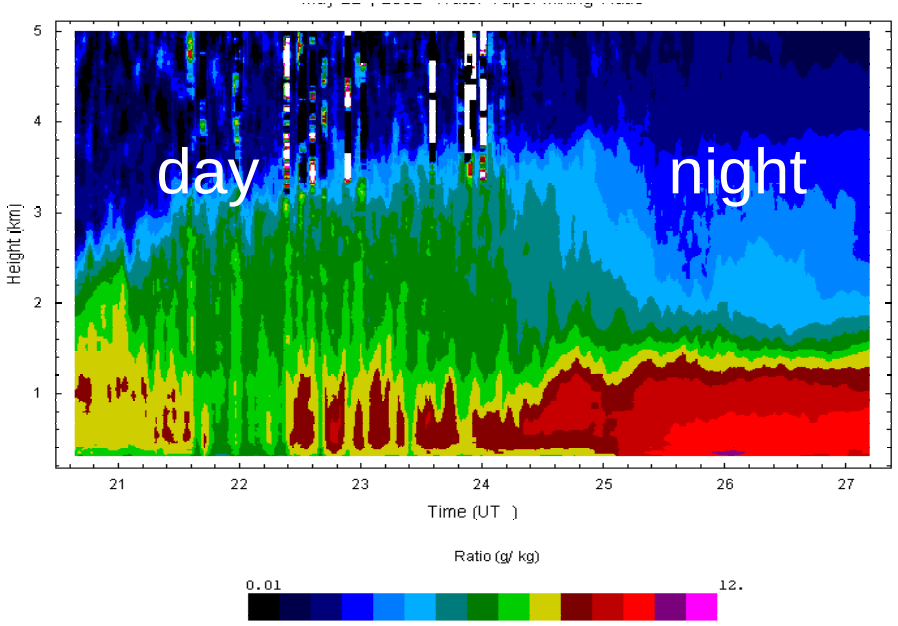
Scanning Raman Lidar Deployed for IHOP



- Telescopes: 0.76 and 0.25 m
- Nd:YAG (9W @ 355 nm)
- All weather windows
- 12 channel AD/PC
- IHOP Measurements
  - Water vapor mixing ratio
  - Aerosol backscatter, extinction, depolarization
  - RR Temperature (DiGirolamo et. al.)
  - Cloud ice and liquid water
- Water vapor error characteristics
  - 2 min, 60-210 meters
  - day <10% in Boundary Layer
  - night <2% in BL, <10% to 6km
- SRL measurements being used for dryline, bore, BL evolution, instrument intercomparison studies from IHOP
- Updated water vapor processing for IHOP now available

http://ramanlidar.gsfc.nasa.gov

May 22, 2002 Dryline



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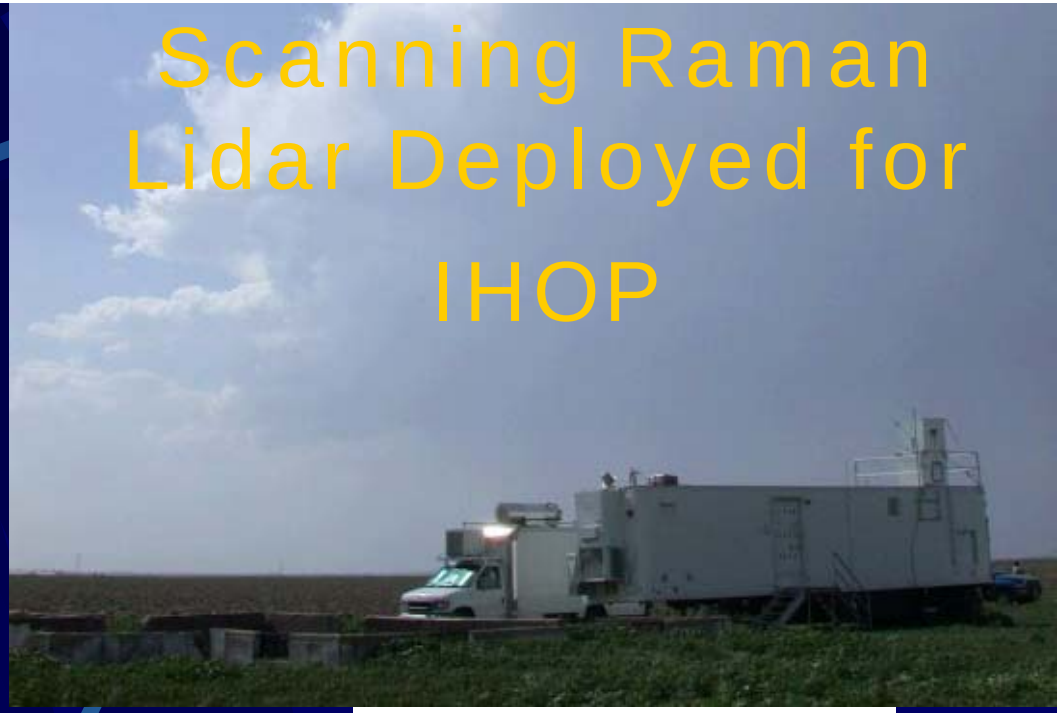

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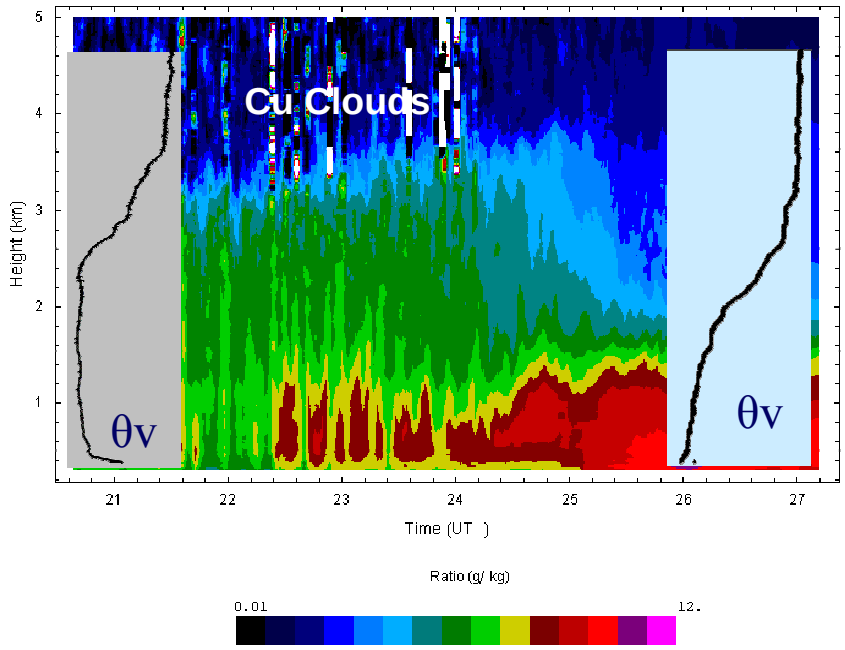
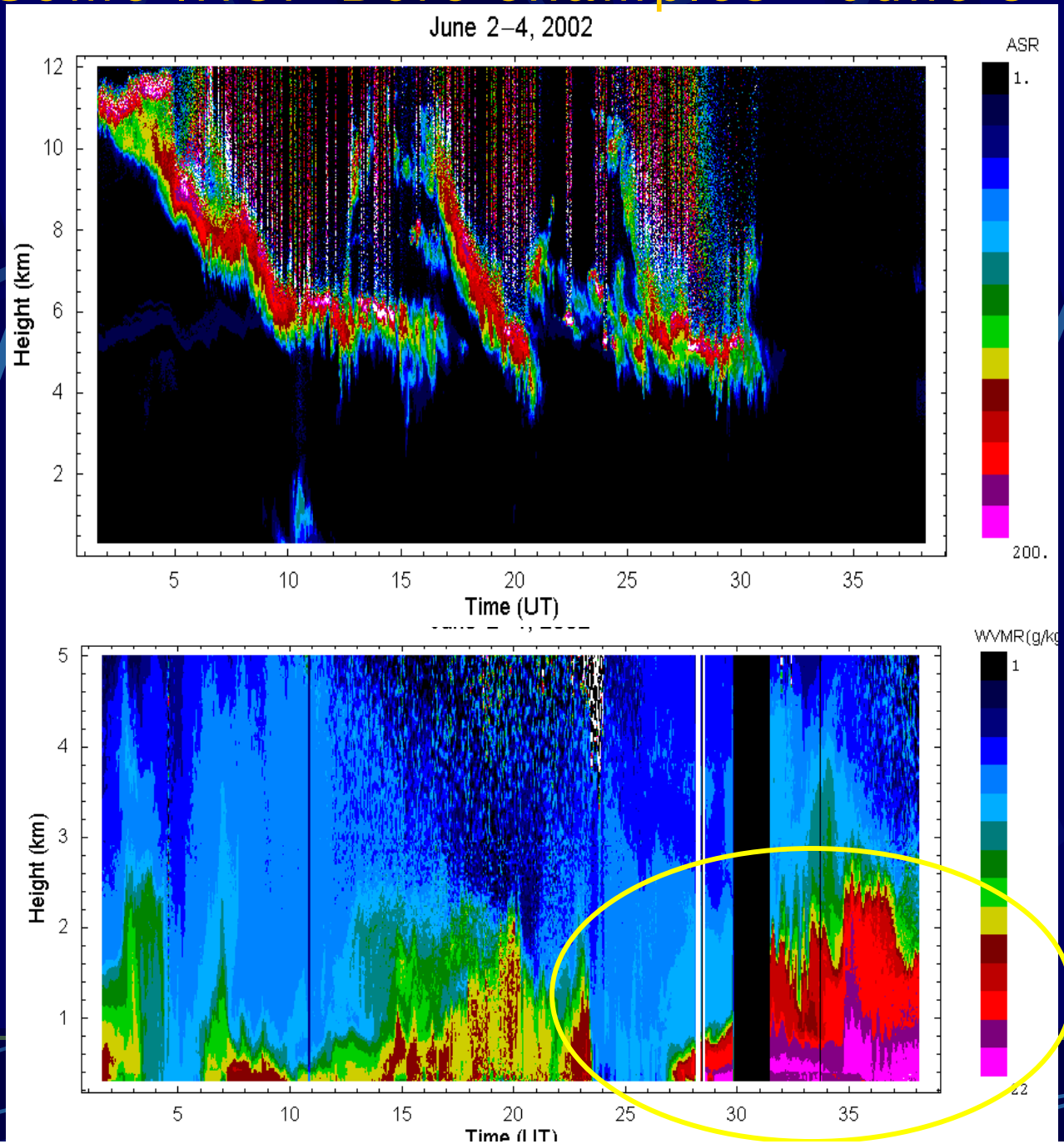
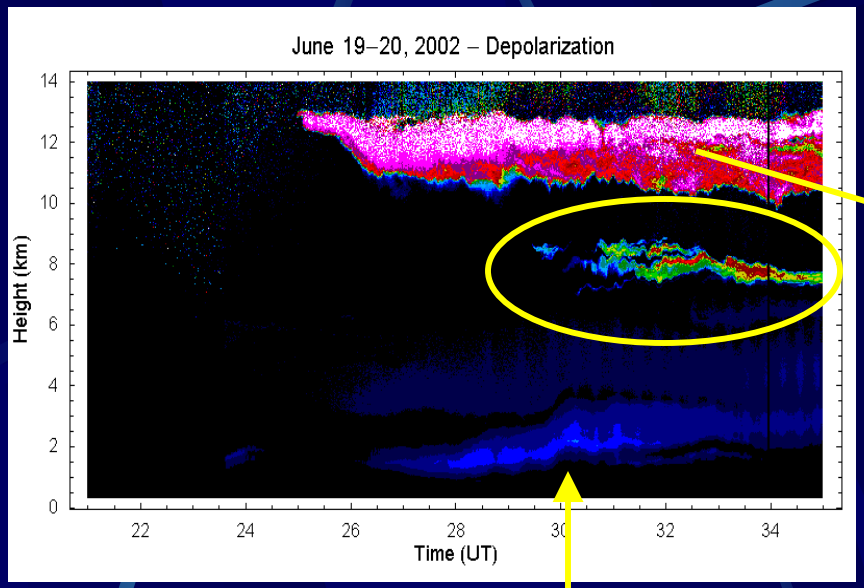
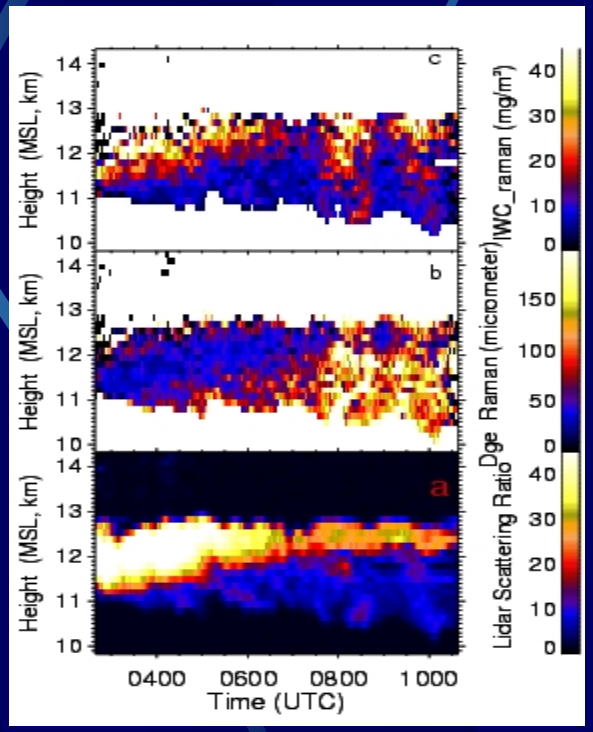


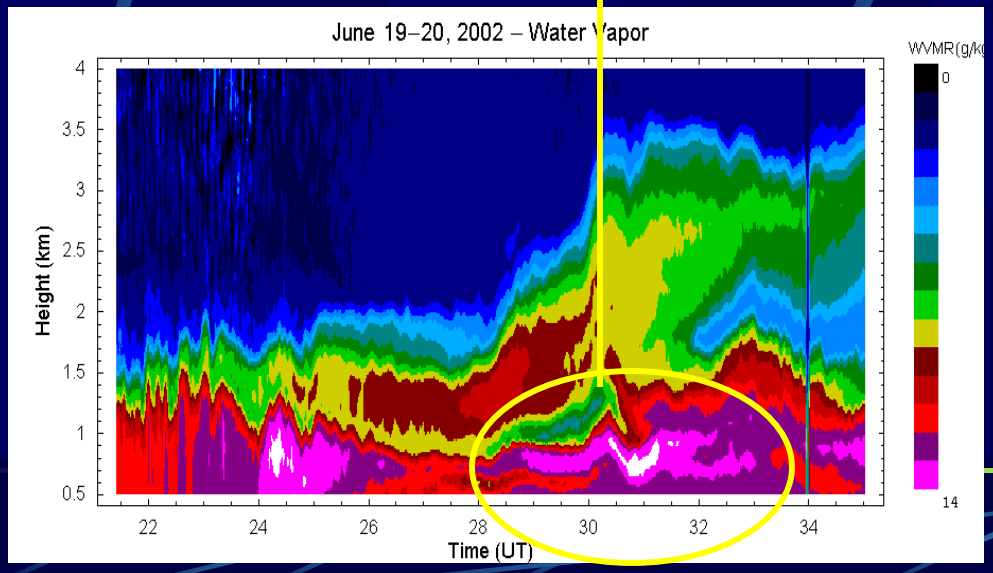
Some IHOP Bore examples – June 3-4, 2002



June 19-20, 2002





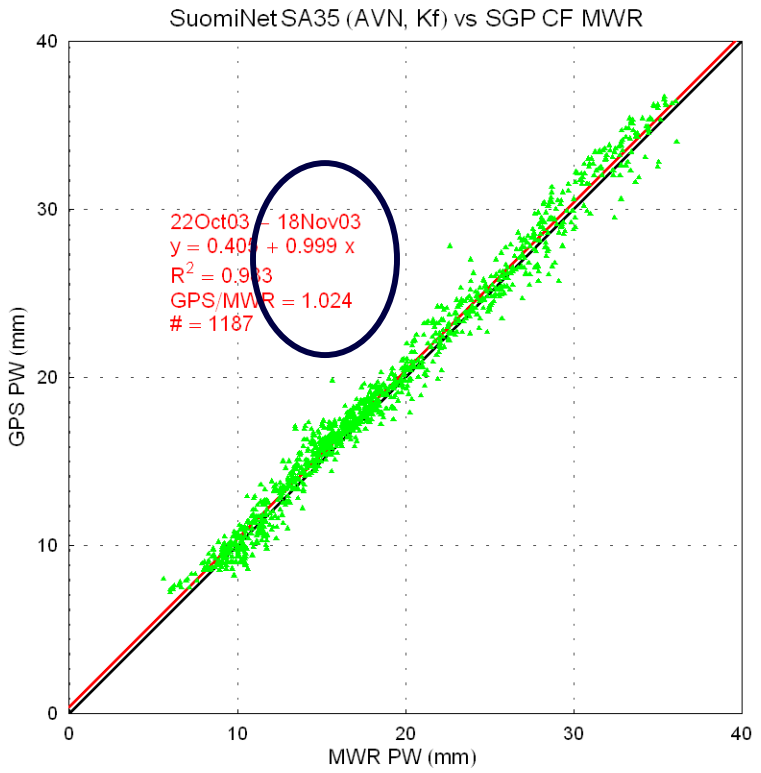


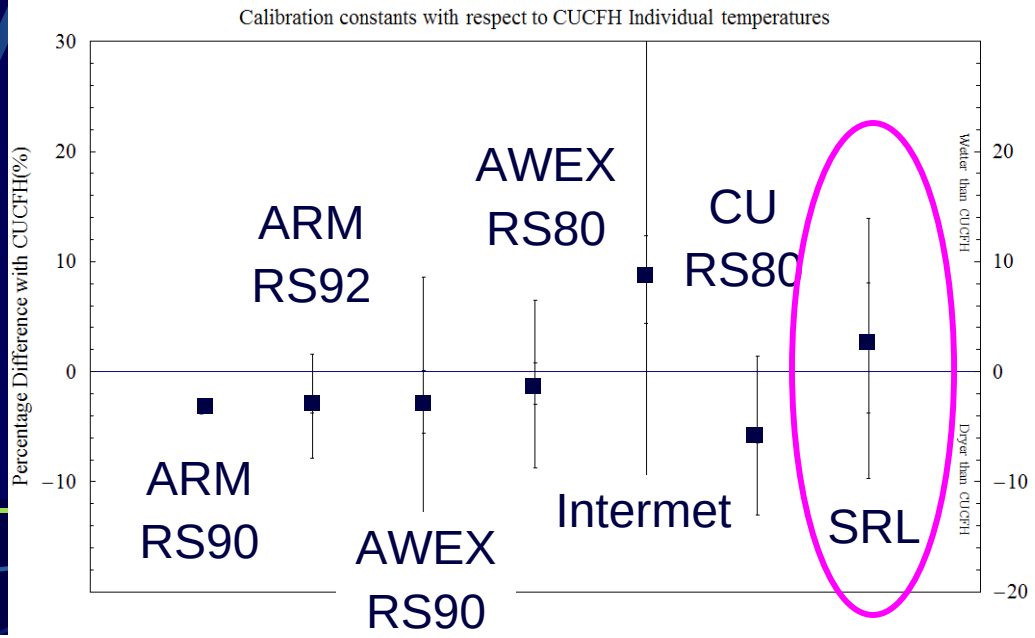
Cirrus Cloud Ice Water Content and Particle size Retrievals

Wang et. al., GRL, August, 2004

Calibration and Intercomparison Results

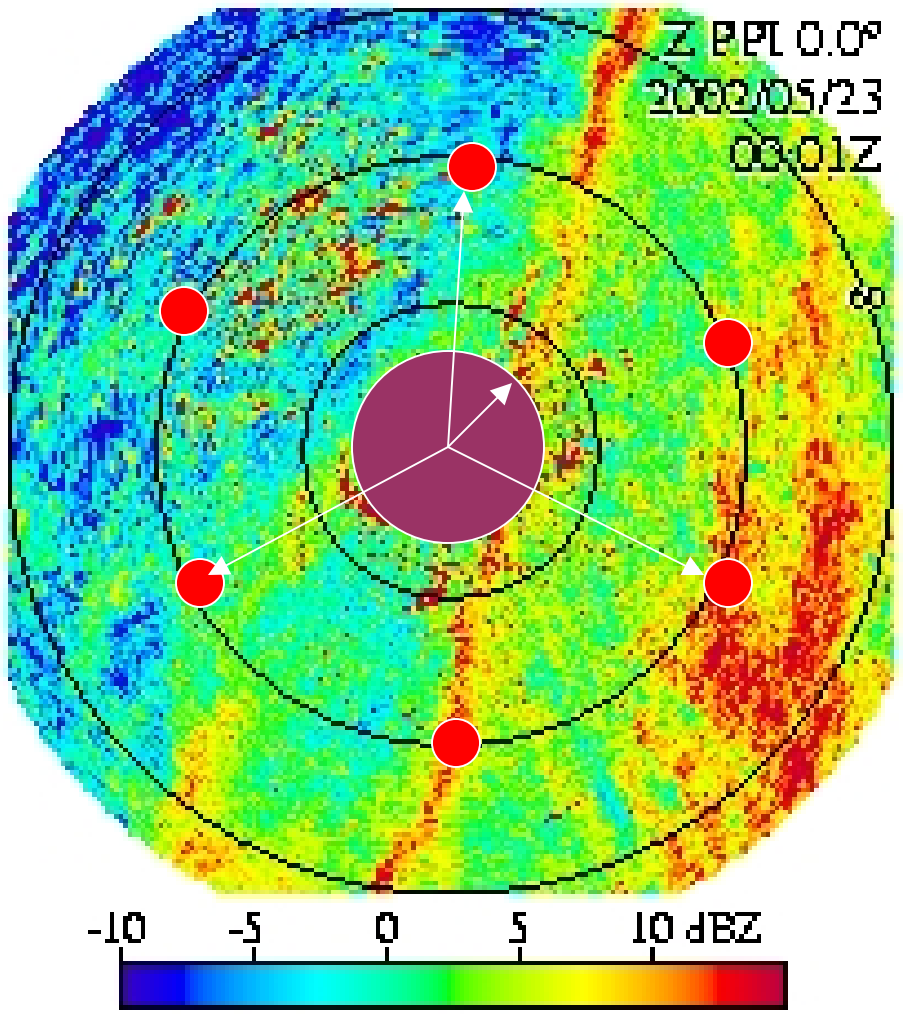
- SRL mobile calibration source (SuomiNet GPS) agrees within 2% of DOE ARM water vapor standard
  - Day and night IHOP calibration agree within 1%
- IHOP (2002) tropospheric profile comparisons
  - <5% mean bias with respect to LASE in lowest 4 km
  - <5% mean bias with respect to Chilled Mirror Hygrometer (SnowWhite) in lowest 6 km
- AWEX (2003) upper tropospheric comparisons
  - Mean PW between 7km – troposphere agrees within 2% of CU-CFH cryogenic frostpoint hygrometer





Data Assimiliation Study Dryline May 22, 2002

- Consider a network of automated, eye-safe 24/7 water vapor, aerosol Raman lidar system in an experiment like IHOP
- Use data assimilation techniques to study the impact of different water vapor lidar systems/configurations on mesoscale modeling
  - Use a high-resolution mesoscale model to "predict" the measurements of lidar systems
  - Nudge the initial conditions and re-run the model
    - Study how well different "measurements" constrain the model predictions
- Study drylines, fronts, bores

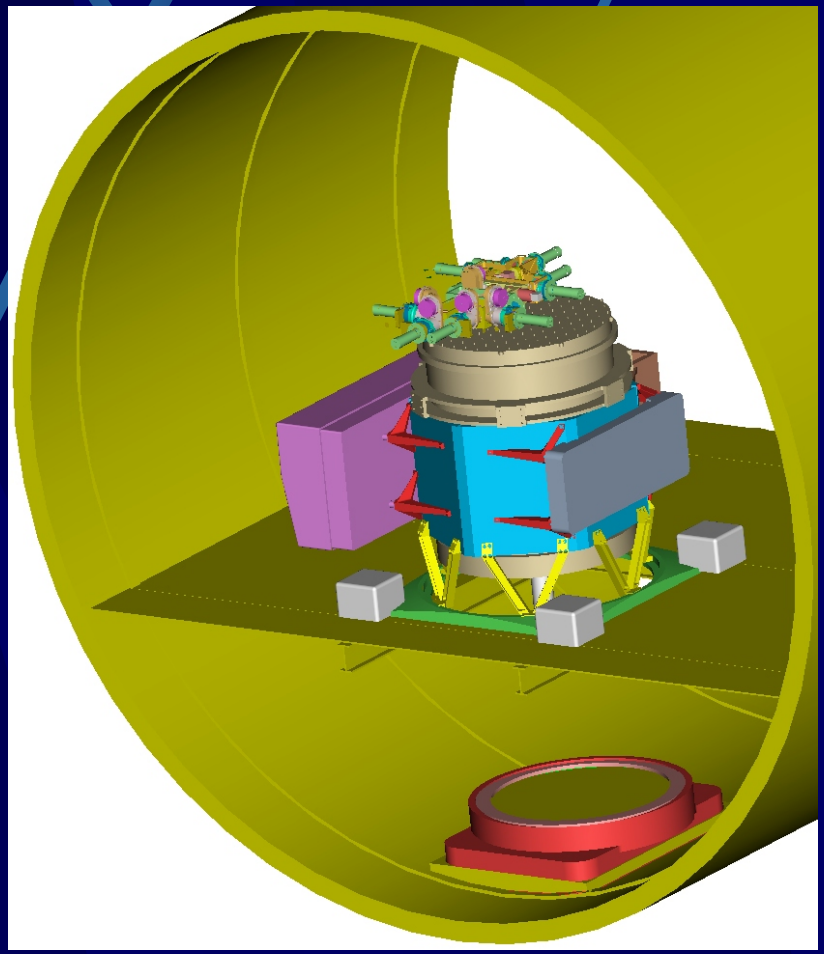


22 May IHOP2002 dryline: illustrating the scales of interest. Scanning water vapor lidar (30km diameter) is placed at the center surrounded by continuously profiling Raman lidars.

Raman Airborne Spectroscopic Lidar (RASL)

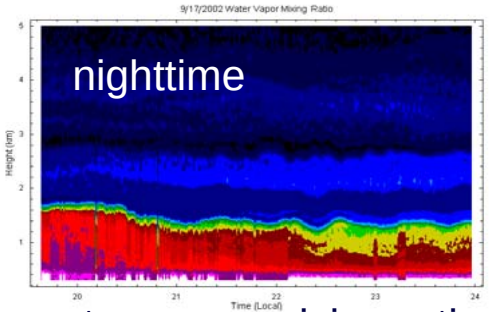
- Water vapor mixing ratio
- Aerosol backscatter, extinction, depolarization
- Research mode
  - Cloud liquid, ice water
  - CO_2
- Eye-safe beyond 500m
- Compatible aircraft
  - P-3
  - DC-8
  - Dash-7
- Being configured for first flight
  - Spring 2005

RASL during lab testing

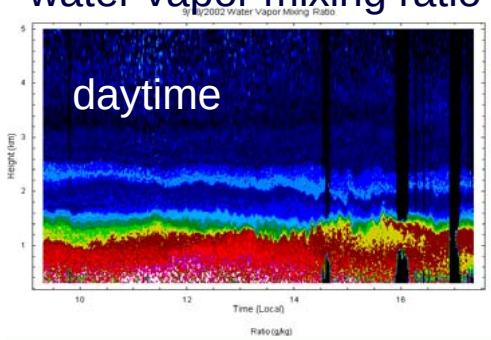


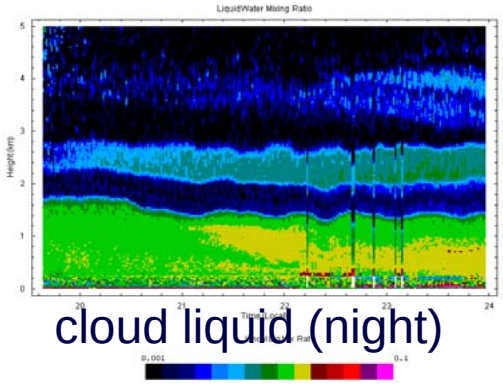
Concept of RASL in the P-3

RASL first measurements Sept, 2002

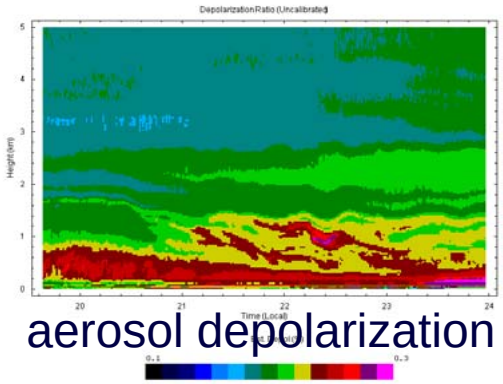


water vapor mixing ratio

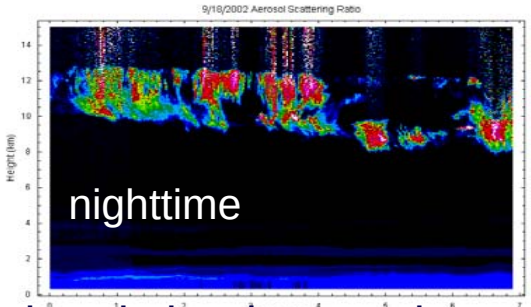




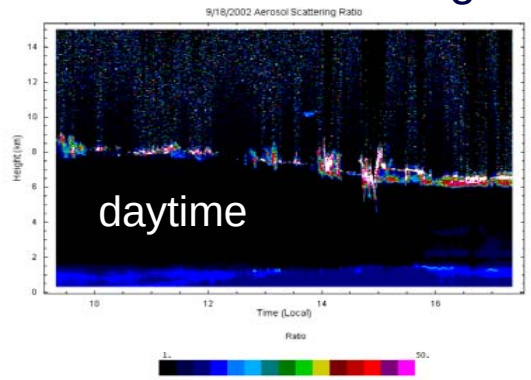
cloud liquid (night)



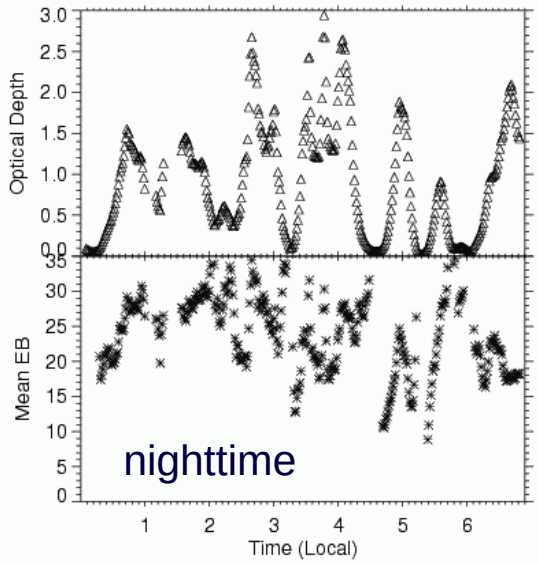
aerosol depolarization

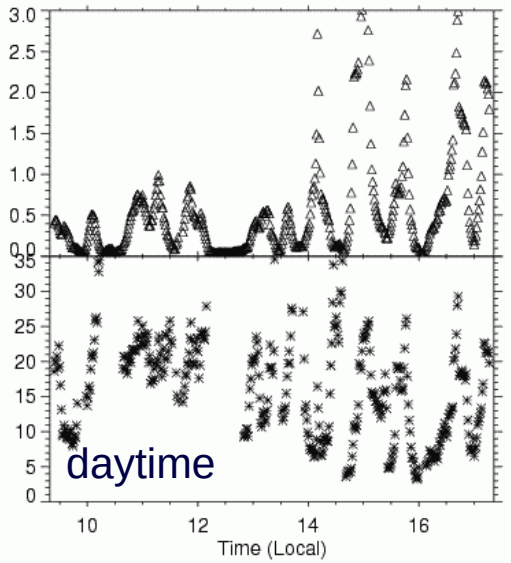


aerosol and cloud scattering ratio



cloud optical depth and lidar ratio



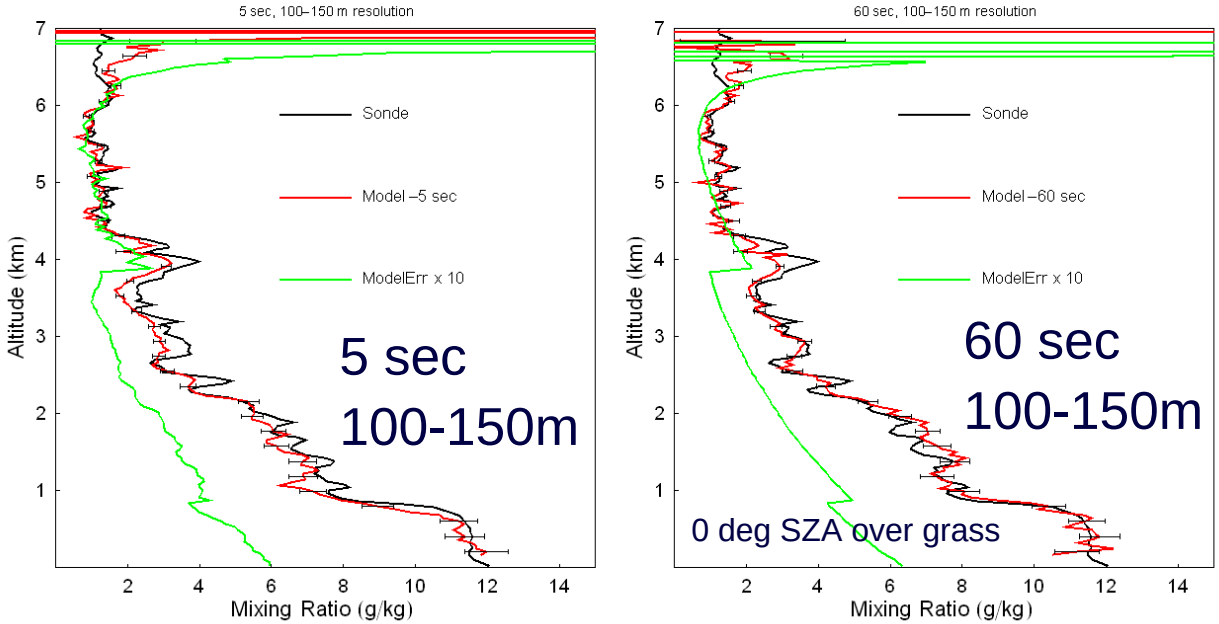


RASL Airborne Simulations

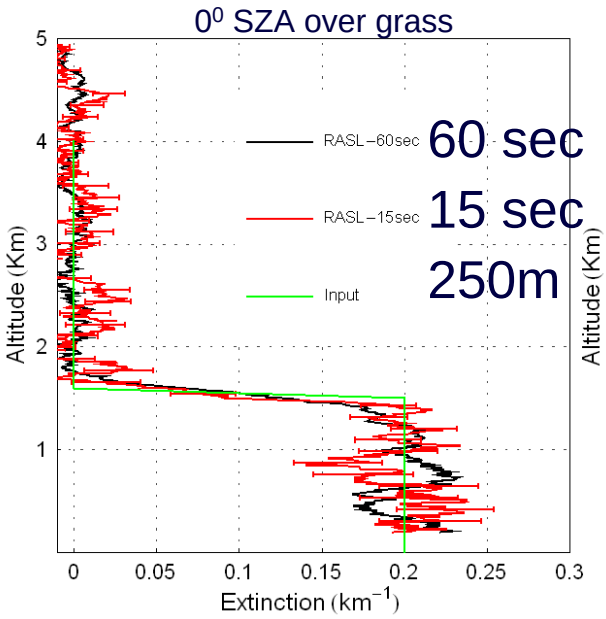
- Quantities
  - Water vapor mixing ratio
  - Aerosol extinction
    - A surrogate for cloud CCN?
- Simulated parameters
  - Flight altitude 7 km
  - Averaging time
    - Nighttime-5 sec
    - Daytime-15,60 sec
- Errors
  - 5-10% (20%) for both water vapor and aerosol extinction

Appl. Opt. 40 (3), 375-390 (2001)

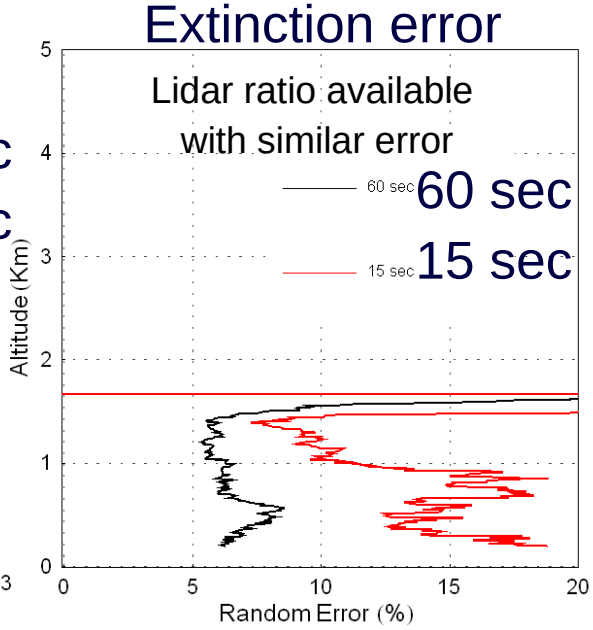
Nighttime Water vapor mixing ratio Daytime

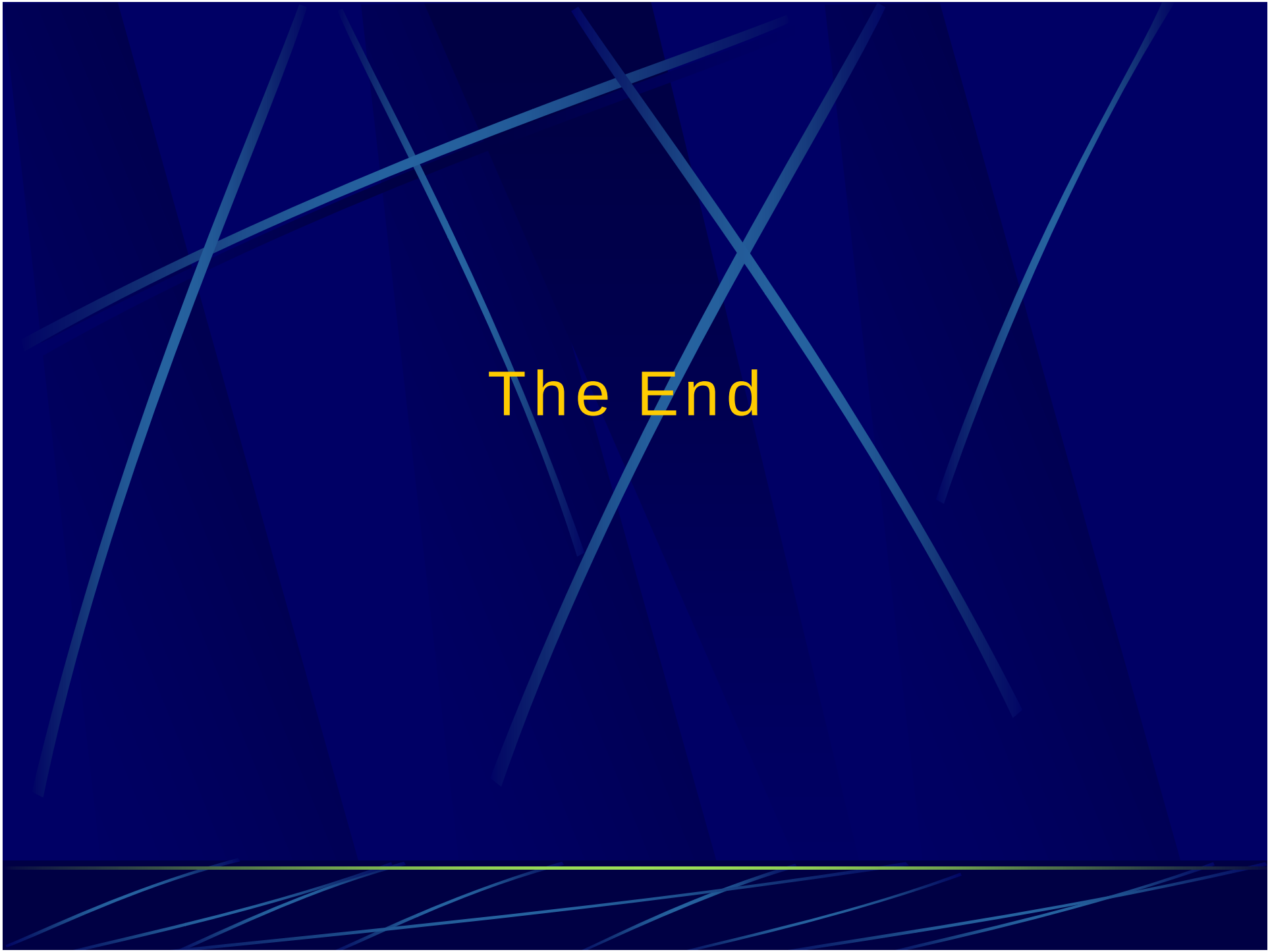


Daytime aerosol extinction

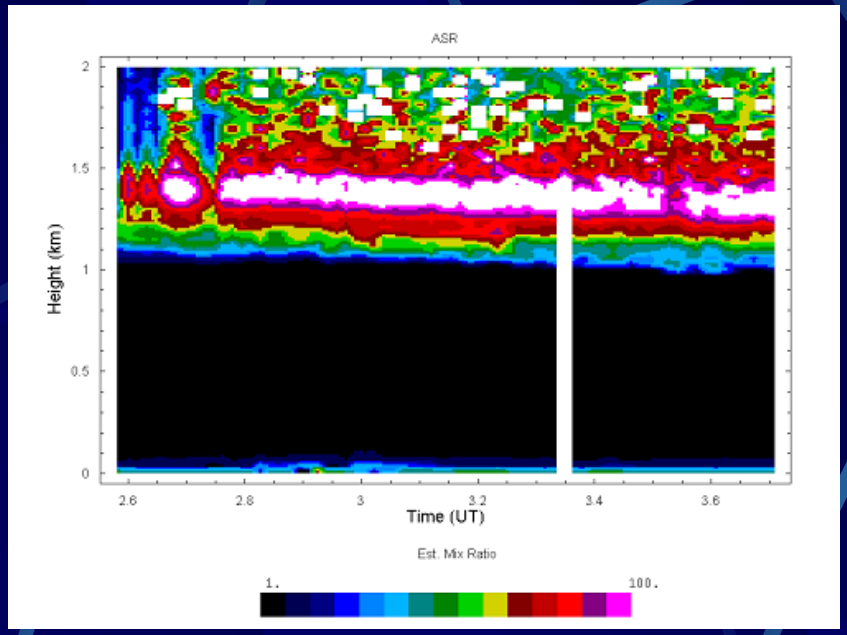


Extinction error



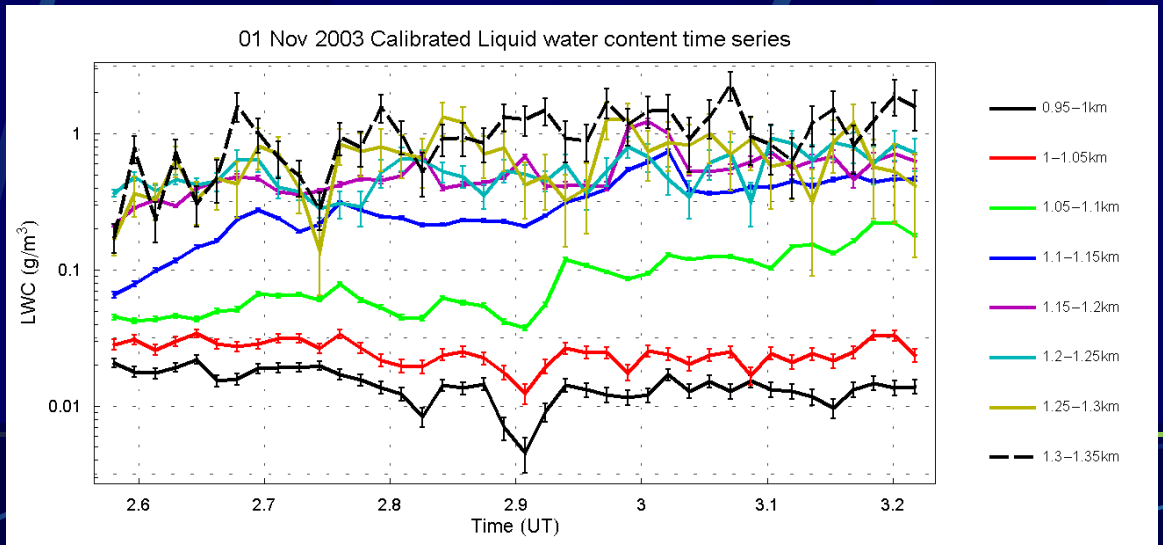

The End

Cloud liquid water measurement – Nov 9, 2003



Cloud scattering ratio

Cloud liquid water



Airborne CO_2 Simulation