

Development of a Compact Airborne Raman Lidar for the Boundary Layer Aerosol and Water Vapor Study



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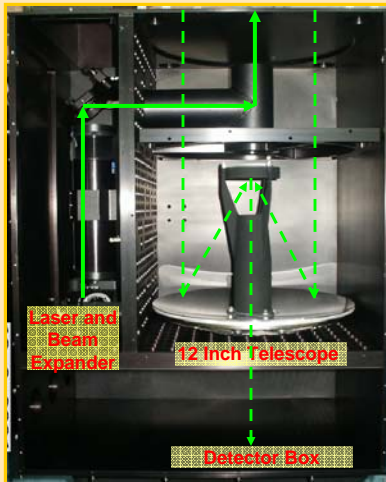
Motivations

One important feature of the atmospheric boundary layer aerosol and water vapor distributions is their spatial inhomogeneity, which presents many challenges to advance our understanding of the interactions of atmosphere and land-surface and to accurately quantify aerosol effects. Raman lidar has proven to be an effective tool to characterize boundary layer aerosol and water vapor (Philbrick 1994; Goldsmith et al. 1998; Weckwerth et al. 1999; Whiteman et al. 2001). To improve University Wyoming (UW) King Air based observational capabilities, we are developing a compact airborne Raman lidar for the boundary layer aerosol, water vapor, and cloud measurements.

Develop a compact airborne Raman lidar system

System applications:

1. Boundary layer water vapor profiling (within 1km range);
2. Boundary layer Aerosol and cloud profiling;
3. Integrate Raman lidar with in situ aerosol and cloud instruments.



The picture on the right shows the compact Raman lidar system.

Improve the integrated in situ and remote sensing capability of the Wyoming King Air

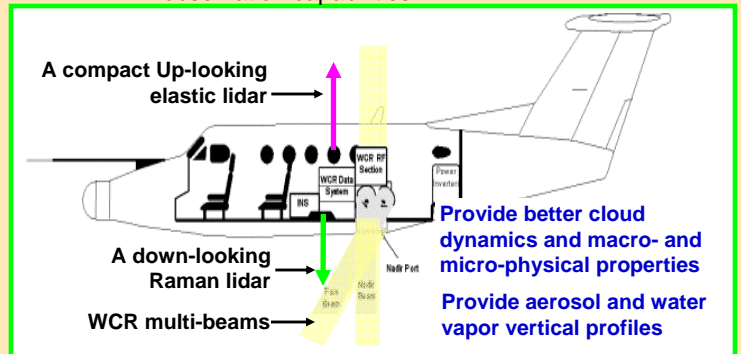
The UW King Air facility:

an NSF supported national lower atmospheric observing facility (<http://flights.uwyo.edu/>). Current observational capabilities:

In situ sampling: aerosol, cloud, and trace gases

Remote sensing: the Wyoming Cloud Radar (WCR), a multi-beam airborne cloud radar; radiometers

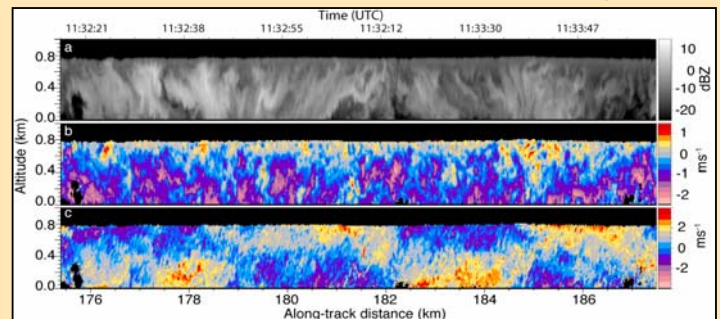
Future development: Integrated lidar measurements with the WCR and in situ probes to provide better atmospheric observation capabilities



System specification of the Raman lidar system

Transmitter			
1. Nd:YAG laser (Big Sky CRF400)			
Wavelength	354.7 nm		
Pulse energy; repetition frequency	50 mJ; 30 Hz		
Beam divergence ((after the beam expander)	0.1 mrad (full angle)		
Receiver			
1. Telescope			
Aperture (diameter);	300 mm		
Field of View (mrad)	Changeable 0.2 -1.0		
2. Optical detection system			
Measurement	Wavelength	Bandpass	
Rayleigh-Mie parallel and perpendicular channels (PC/AD)	354.7 (nm)	0.3 (nm)	
Raman water vapor (PC)	407.5 (nm)	0.3 (nm)	
Raman nitrogen (PC/AD)	386.6 (nm)	0.3 (nm)	

An example of WCR measured cloud structure and dynamics



The figure shows the measured cloud structure and dynamics during the DYCOMS-II project. a) Reflectivity; b) vertical Doppler velocity; c) horizontal velocity. Positive velocities are from left-to-right in the 3rd panel (Provided by Dr. Dave Leon).