

New Combined Lidar and Radar Measurement Capability from Wyoming King Air

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1. Introduction and conclusion

A better understanding of cloud microphysical and dynamical processes are needed to better simulate cloud feedbacks in GCMs.

The Wyoming Cloud Lidar (WCL) is a newly built compact elastic polarization lidar (upward pointing) to provide cloud boundary as well as backscattering and depolarization ratio profiles.

The Wyoming Cloud Radar (WCR), which has served the atmospheric community for more than 10 years, provides cloud structure in terms of radar reflectivity and Doppler velocity as well as cloud scale dynamics above and below the aircraft.

The combined WCL and WCR measurements from Wyoming King Air allow us to apply different remote sensing retrieval algorithms to better characterize cloud macrophysical and microphysical properties.

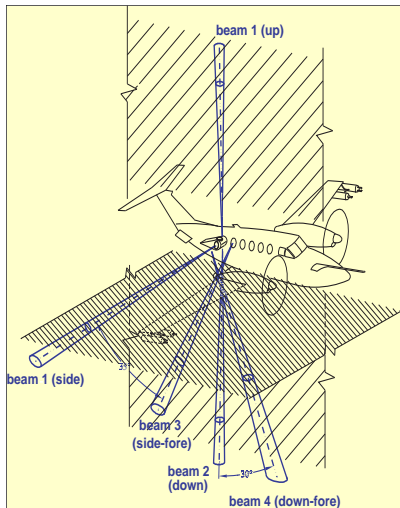
Examples are presented to show the individual capabilities of WCR and WCL and the potential to combine them for cloud study.

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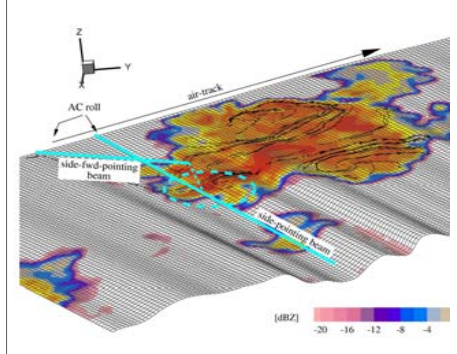
2. WCR (<http://www.atmos.uwyo.edu/wcr/newwcrpage/>)

WCR Specification:

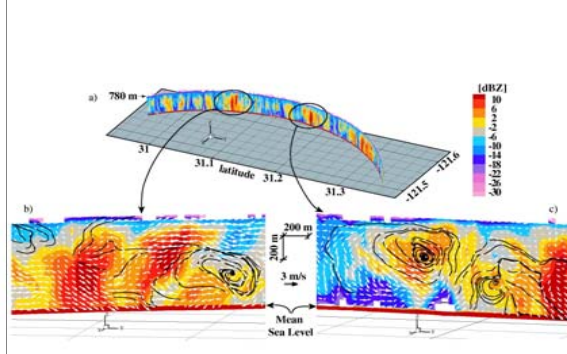
Transmit Frequency	94.92 GHz ($\lambda=3.16$ mm)
Peak Power / Max Duty Cycle	1.6 KW / 1 %
Pulse	100-500 ns
Pulse Repetition Frequency (prf)	1000 Hz – 20 KHz
Antennas:	4
aperture beamwidth polarization	
▪ Side/Up (beam 1, use mirror for Up)	0.31 m 0.7° H, V
▪ Side-fore (beam 3, 36° forward)	0.31 m 0.7° single, linear
▪ Down (beam 2, near nadir)	0.46 m 0.5° single, linear
▪ Down-fore (beam 4, 26° forward)	0.38 m 0.6° single, linear
Antenna modes (typical):	Beams:
▪ DPDD (dual-plane dual-Doppler)	1,2,3,4
▪ VPDD (vertical plane dual-Doppler)	2,4
▪ VPDD + up or side	1,2,4
▪ HBDD (horizontal beam dual-Doppler)	1,3
▪ HBDD+down	1,2,3
▪ Profiling (up+down or side+down)	1,2
▪ Profiling (up+down) + side-fore	1,2,3
Dwell time/ Along-track sampling	30 ms / 3 – 5 m (typical)
Min. detectable signal (side-antenna, 1 StDev above mean noise)	-30 dBZ @ 1km, 250ns, 500 avrg



Cloud Scale Horizontal Wind Measurement



Cloud Scale Vertical Wind Measurement

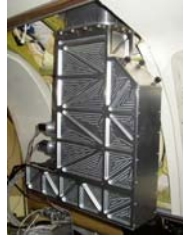


3. WCL

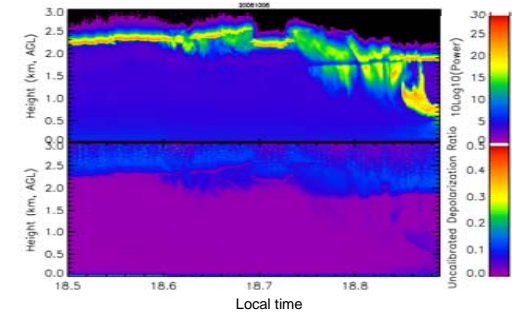
WCL Specification:

Transmitter	
•Laser Wavelength	355 nm Nd:YAG
•Pulse Repetition Frequency	20 Hz
•Pulse width	~8 ns
•Pulse Energy	16 mJ
Receiver	
•Diameter	~ 75 mm
•Field of view	300 and 2000 μ rad
Data System	
•Number of Channels	Two
•Detector	PMT
•Spatial Resolutions	Vertically: 3.75m, 7.5m, 15m, 30m (programmable) Horizontally: ~20m
•Data acquisition system	Combined analog and photon counting system from LICEL, GmbH

Left : Photo of WCL installation on the Wyoming King Air: A compact and robust lidar system

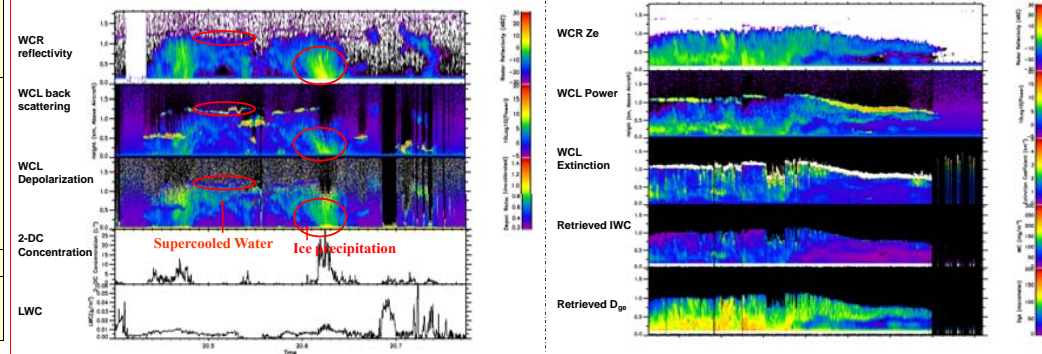


Below: An example of ground-based measurements shows lidar dark band indicating the melting level.



4. Examples of combined WCL and WCR measurements

a. Examples from Wyoming King Air: Mixed-phased altocumulus



b. Examples from C-130 during the ICE-L: Wave clouds

