P1R.3 W-BAND ARM CLOUD RADAR

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1. INTRODUCTION

The W-Band ARM Cloud Radar (WACR) is a dual polarization 95 GHz radar that was recently installed at the DOE Southern Great Plains (SGP) Cloud and Radiation Test (CART) site. The WACR system, shown in Figures 1-3, is located in the existing 35 GHz Millimeter Wave Cloud Radar (MMCR) shelter.

2. SYSTEM DESCRIPTION

The WACR system include a high peak power (1.6 kW) EIKA transmitter, low noise receiver, and PC-based digital receiver. WACR is configured to measure co-polarized and cross-polarized Doppler spectra, at height resolutions of 15, 45 and 90 meters. Table 1 summaries key system parameters.

Table 1. Key system parameters

Radar Specification	Value
RF output frequency	95.04 GHz
Peak transmit power	1.67 kW
Transmitter duty cycle	1% max
Pulse widths (selectable)	100, 300, 600 ns
Transmit polarization	Linear
Receiver polarizations	Co- or Cross-polarization
W-band LNA noise figure	4.8 dB
IF output to digital receiver	120 MHz
System sensitivity at 2 km	-45 dBZ with 2 s average
Antenna integrated cross-polarization isolation	-30 dB

3. SYSTEM CALIBRATION

After each 2 second acquisition, the system performs an internal calibration to monitor receiver gain, noise figure and transmitter output power. Typical plots of noise figure and gain are shown in Figure 4 for a 24 hour period. Transmit power is also monitored using a detector sampling the output of the EIKA through a 20 dB directional coupler.

An electronically controlled splash plate, adjustable in azimuth and elevation, is mounted on the roof of the MMCR shelter (Figures 2-3). The splashplate deflects the antenna beam in the direction of a tower-mounted corner reflector to periodically calibrate the radar.

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Figure 1. 95 GHz W-band ARM Cloud Radar ceiling mounted upper rack containing RF Unit and antenna (left) and lower rack (right) containing RF unit chiller, data system, UPS, modulator controller and digital scope for transmit sample display.

Figure 2. Rooftop mounted radome, calibration splashplate, and blower assembly.

Figure 3. Rooftop equipment installed in the MMCR shelter at the SGP CART site.

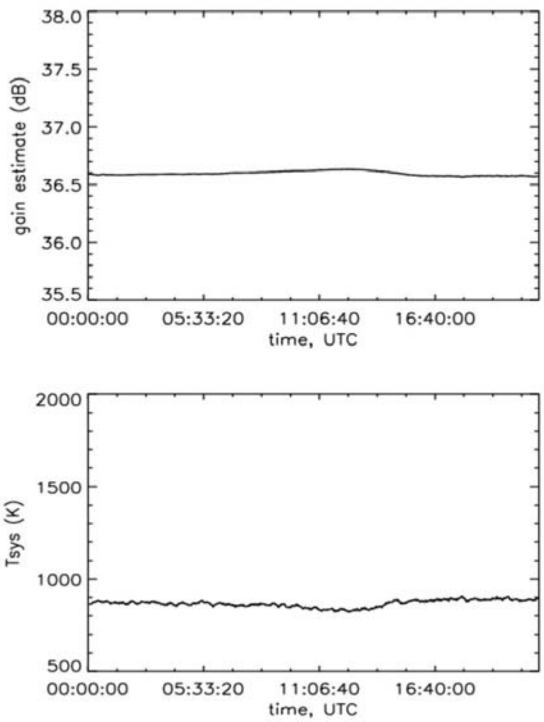

Figure 4. Time history of receiver gain and noise figure (from LNA to digital receiver) derived from ambient load and hot load measurements.

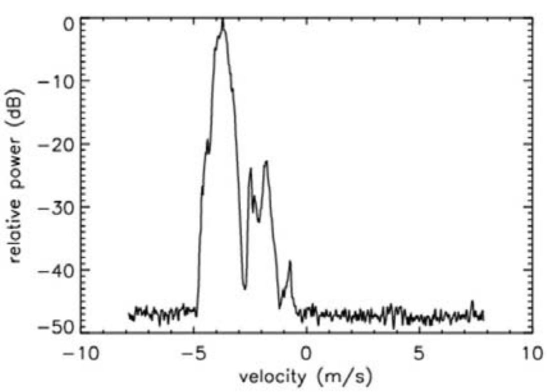

Figure 5. Doppler spectrum showing multi-modal spectrum with 47 dB SNR.

4. APPLICATIONS

Joint observations with the WACR and MMCR systems will provide dual wavelength data for improved cloud parameter estimation. The WACR system is less sensitive than MMCR to backscatter from insects, due to Mie scattering effects and reduced antenna gain. This difference in scattering will be used to discriminate between insects and clouds in the atmospheric boundary layer.

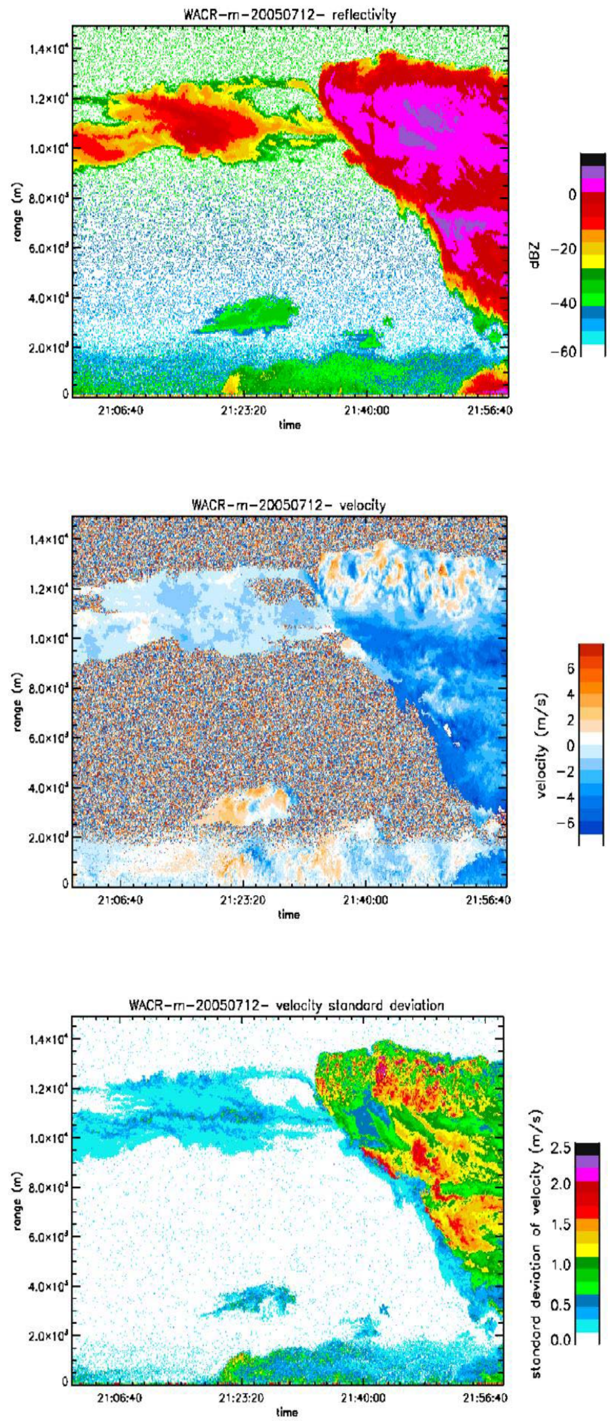

Figure 6. Reflectivity, mean velocity and velocity standard deviation for vertical profile of the leading edge of thunderstorm at the SGP CART site, July 12, 2005.