5.3A CHARACTERISTICS OF SUNSET RADAR

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The Sunset radar is a VHF, pulsed Doppler radar located in a narrow canyon near the Sunset townsite 15 km west of Boulder, CO. This facility is operated by the Aeronomy Laboratory, ERL, NOAA, exclusively for meteorological research and the development of the MST and ST radar technique.

ANTENNA

The antenna system consists of two colocated arrays, each containing 16 lines of coaxial-colinear dipoles. One of these arrays can be steered in the N-S vertical plane and the other in the E-W plane. The phase progression necessary for steering the antenna beam is provided by the insertion of remotely controlled phase shifters in the transmission line to each line of dipoles. The phase shifters have binary format (i.e., phase increments of $\lambda/2$, $\lambda/4$,....... $\lambda/256$ can be summed). The practical range of beam steering for meteorological experiments is ± 45 due to the loss of antenna gain with increasing zenith angle. The beam steering increment near the zenith is 0.4° to take advantage of the sharp nulls in the antenna pattern. The phase shifters also perform the switching between the two arrays. Each phase shifter is controlled by the on-line computer.

DATA PROCESSING

On-line data processing is performed by a Nova 800 computer. This computer provides radar control, antenna steering control, spectral analysis by a FFT algorithm, spectral averaging, on-line spectral plotting, and output to a tape recorder and a hard copy unit. Control of the radar is by a "menu" subroutine that allows immediate changes in range gate altitudes, range gate length, number of spectra averaged, and antenna beam position. Sequences of antenna positions may also be specified.

Coherent averaging is provided by analogue filters on each of the 16 range gates. The effects of ground clutter are reduced by a 0 - 0.1 Hz notch in the response of these filters. Coherent averaging is especially effective because of the high pulse repetition frequency of the radar (typically 6 kHz).

Since March, 1981, calibration signals from a stable noise generator have been placed on each data tape for each mode of operation used. These calibrations, along with the recorded transmitted power, are used to determine absolute radar reflectivity.

Magnetic data tapes are further processed by a scaling program on the central computing facility of the Boulder Laboratories of NOAA. The output of this program contains radial velocity, velocity width, received power, C_n^2, and the magnitude of the reflection coefficient for each range gate.

HISTORY AND SIGNIFICANT ACCOMPLISHMENTS

The Sunset radar was the first radar designed and constructed specifically

Summary of Sunset radar characteristics

Frequency	40.475 MHz
Wagelength	7.41 m
Transmitter power	
Peak	100 kW
Average (maximum)	16 kW
(typical)	2.5 kW
Antenna	
Phased array of coaxial-colinear dipoles with computer-controlled phase shifters for each line of dipoles	
Area	3600 m^2
Aperture efficiency	0.58
Resistive loss	0.30
Steerability	
(E-W or N-S vertical plane only)	$\pm$ 60°
Beam width H plane (steerable)	4.8°
E plane	4.4°
Steering increment	0.2°
Practical steering rate	1 record/minute/position to any arbitrary antenna beam position

as a VHF ST radar. Construction was begun in 1973 and the first clear-air echoes and wind velocity measurements were obtained in 1974 (GREEN et al., 1975). The Sunset radar has been used to demonstrate the feasibility of using an ST radar to measure wind velocity (WARNOCK et al., 1978), all three vectors of wind velocity (GREEN et al., 1978a), turbulence (VANZANDT et al., 1978), wind variability (GAGE and CLARK, 1978), variation of clear air turbulence near and above thunderstorms (GREEN et al., 1978b), simultaneous measurement of hydrometeor and air velocity (GREEN et al., 1978b), turbulence intensity using velocity width (1978c) specular reflection from stable layers (GAGE and GREEN, 1978), gravity (buoyancy) waves (VANZANDT et al., 1979), the height of the tropopause (GAGE and GREEN, 1979b), turbulence parameters (GAGE et al., 1980); devise a practical and economical method of steering ST radar antennas (GREEN et al., 1981); and estimate the gradient of temperature in the stratosphere (GAGE and GREEN, 1982).

(References in this paper are included in the Publications listed below.)

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