9.13A THE ADELAIDE VHF RADAR - CAPABILITIES AND FUTURE PLANS

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The VHF radar at Buckland Park, South Australia (35°S, 138°E) commenced operation in January, 1984. The radar is located adjacent to the 2-MHz ionospheric radar. The routine method for measuring horizontal wind velocity is the spaced antenna technique (SA) while the Doppler technique is used to measure vertical velocities. It is possible to swing the transmitting beam in the east-west plane, allowing Doppler measurements of the EW wind component.

The basic system parameters (SA mode) are given in Table 1. The Yagi arrays are arranged in an equilateral triangle 40 m on a side with the spacing determined by theoretical calculations of the scale of the received pattern. The transmitting and receiving equipment is microprocessor controlled. The data are analyzed in real time on a minicomputer; the results are stored on magnetic tape for further off-line analysis.

Winds are measured in the lower stratosphere and regularly up to 9 km in the troposphere. Comparisons between the radar measurements and radiosonde measurements taken at Adelaide Airport (35 km to the south) show excellent agreement (e.g. Figure 1).

FUTURE DEVELOPMENTS

The transmitter power is to be increased to a mean of about 10 kW. Three approaches have been considered: a single high power transmitter to drive the whole array; individual solid-state modules driving each element; individual valve modules driving each element. The relative attributes of these approaches is given in Table 2. It is clear from this table that the solid-state approach is the most advantageous.

One module has been designed, built and tested. It appears that 500 watts peak output can be obtained from each output transistor without failure even when "operated into an infinite VSWR". With an optimum load connected, failure becomes significant above 700 watts peak. We have decided to operate the devices at the conservative output power of 500 watts per device. The gain at this level is about 12 dB and the efficiency is better than 50%. Table 3 summarizes the characteristics of each module.

Varicap diodes will be used to set the relative phase of the modules when swinging the beam. The phase of each module will be stabilised by phase feedback.

The receiver for the main array will consist of a low noise preamplifier connected to each antenna element followed by a phase shifter and combining network. Sixteen modules capable of delivering 5 kW mean power to the antenna are now under construction and will be in operation by late 1984. Construction of another sixteen modules is planned for 1985.

With the construction of a TR switch it is now possible to make Doppler wind studies using the large array for both transmission and reception. Beam pointing studies in the EW plane are now being started to find the optimum pointing and to study the effect of aspect sensitivity on the effective beam

Table 1. Buckland Park VHF radar, operating frequency 54.1 MHz

TRANSMITTING ARRAY	RECEIVING ARRAYS
32 coaxial colinear antennas Area: 8000 m^2 Half power beamwidth: 3.2° Ground plane spacing: 0.1λ	3 x square arrays of 16 five-element Yagis Area: ~250 m^2 Half power beamwidth: 18°
Transmitter	**Receiver**
Peak power: 40 kW Pulse length: 7 μsec PRF: 512 Hz Mean power: 200 W	3 separate dual-channel receivers with own digitizer and coherent averagers. Integration time: 0.25 or 0.50 s.

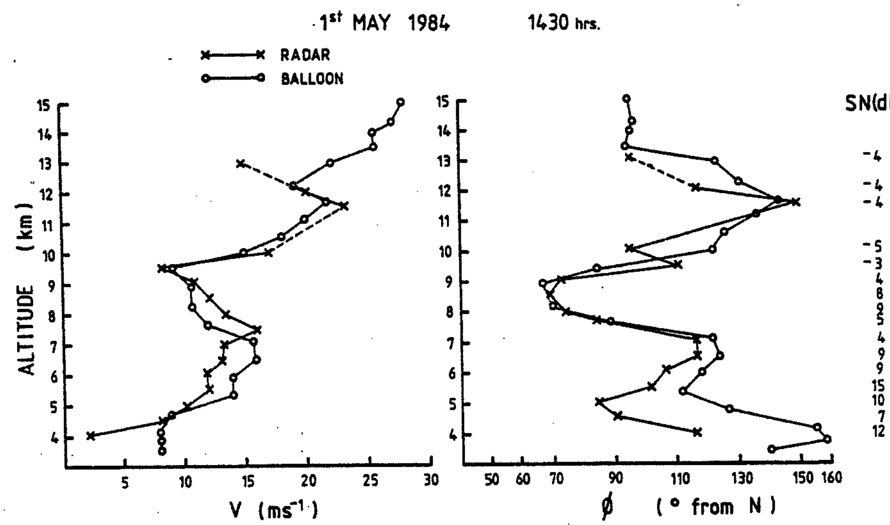

Figure 1

Table 2

		MULTIPLE MODULES	
	SINGLE UNIT	SOLID-STATE	VALUE
Flexibility in steering array	3 or at most 5 positions	continuous	continuous
Cost excluding labor	?*	$46,000* (32 units)	>$70,000*
Cooling	forced air	active water chiller	forced air
Availability of components	difficult	readily available	moderately difficult
Danger in terms of voltage	high	very low	high
Maintenance		lowest	highest

*Only the transistor version has been carefully priced.

Table 3

Peak power	3.5 kW
Maximum duty cycle	20%
Efficiency	50%
Supply voltage	50 V
Bandwidth	7 MHz
Physical dimensions	20 x 15 x 7 cm
Cost	<$1,000 (excl. labor and cooling)

point angle. Four angles are being used for the tests: 4, 7, 11 and 15°. Once the optimum angle has been chosen then a relay controlled system will be used to point the transmitter beam at complementary angles in the EW plane and thus measure the upward flux of zonal momentum, u'w', carried by gravity waves using the technique of VINCENT and REID (1983).

With the higher transmitter powers available at the end of 1984, simultaneous studies of scattering from the mesosphere at 3 frequencies, (54, 6 and 2 MHz) will be made in order to investigate the structure of the scattering irregularities.

Studies of irregularities in the lower atmosphere are also being undertaken using interferometric techniques. To improve the angular resolution a long baseline interferometer will be constructed by placing a small array composed of yagis at a distance of 500-1000 m from the center of the present system.

Finally, a lidar will be installed adjacent to the VHF radar in 1985. This will be used to measure neutral densities and temperatures throughout the middle atmosphere. The lidar system is now under construction and has been designed by Dr. F. Jacka of the Mawson Institute, University of Adelaide.