

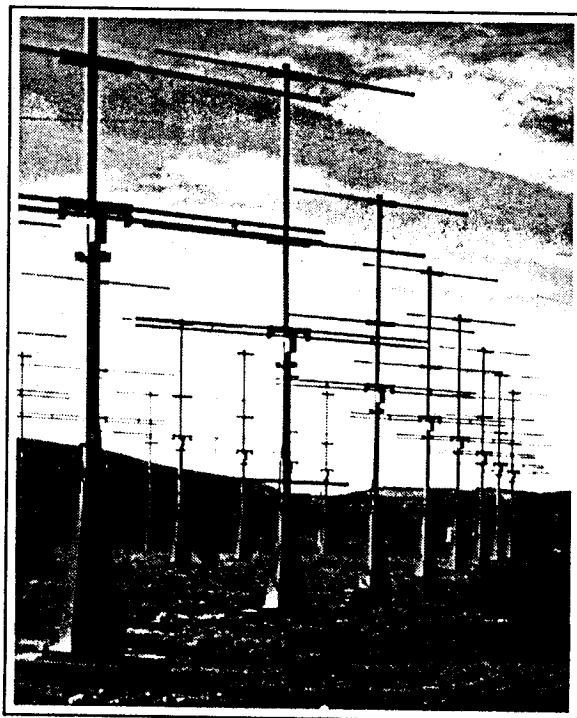


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SUMMARIES AND ABSTRACTS OF PAPERS

HIGH-ALTITUDE-RESOLUTION OBSERVATION OF THE UPPER STRATOSPHERE
AND LOWER MESOSPHERE USING JICAMARCA VHF RADAR

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The high-power VHF radar technique is a powerful tool to investigate winds and turbulence in the middle atmosphere. However, an entire wind or power profile from the upper troposphere to the lower thermosphere (10-100 km) has not yet been obtained. Especially, it is very difficult to observe the so-called "gap region" from 35 to 60 km due to weak echo power. Recently, the Jicamarca VHF radar facility (50 MHz) in Peru has been greatly improved, and a height resolution of 250-500 m is now achieved by pulse compression using 16- or 32-bit complementary codes. This paper presents a preliminary result of Jicamarca radar observations of the upper stratosphere and lower mesosphere, including the "gap region", conducted on Sept. 24-28, 1990.

The Jicamarca radar antenna consists of two collocated crossed-dipole arrays, named the NE and NW arrays, respectively. Each array forms a square of 288 m and contains 9216 half-wave (3 m) dipoles. In this experiment, only the NE (co-pol) array is excited by the transmitter, which has a peak output power of 1.3 MW. The radar echoes are, however, received by both arrays. The NW (x-pol) array is thus used to monitor clutter components which may come from antenna sidelobes. We here assume that the clutter components inherently have random polarizations, so that they must be received by the x-pol array in the same probability as the co-pol array if they exist. The antenna beams of both arrays are pointed to the vertical direction.

For the height resolution of 500 m, a transmitter pulse is coded by 16-bit complementary codes with a subpulse width of 3.33 μ s. The IPP is 1.07 ms and the observed height range is 19-75 km. In this observation, coherent integration is performed 140 times for the received signals. After decoding the complementary codes in height, the resulting complex time series of the received signals are transformed into power spectra using the FFT algorithm on sets of 128 points. The power spectra are further averaged (incoherently integrated) 8 times (about 5 min) or more to detect constant turbulent echoes.

Figure 1 depicts an example of the spectrum contours received by the (a) co-pol and (b) x-pol arrays, respectively. These are averaged for approximately 100 min. The spectral peaks for the co-pol component (a) are clearly found up to 42 km in the upper stratosphere and down to 57 km in the lower mesosphere. Note that those for the x-pol component (b) are not found in this weak echo region. On the other hand, the x-pol spectra seen at heights with strong echoes both in the lower stratosphere and the upper mesosphere are explained in terms of leakage of the received co-pol power due to comparatively poor isolation of the cross dipoles and the power divider. That is, these spectral shapes are quite similar to those of the co-pol component except for 10-15 dB lower values.

The height distribution of the echo power is shown in Fig.2 with the noise level subtracted from each spectrum. The x-pol component (thin line) is, in general, suppressed by 10-15 dB compared with the co-pol component (thick line). The horizontal line indicates the standard deviation of the spectral noise level irregularity. Note that the co-pol echo power has appreciable signal detectability at some height layers even in the 35-60 km range. In contrast, the x-pol echo power is seldom enhanced in this height range. This evidence proves that the Jicamarca radar detects "real" atmospheric echoes other than clutter for the first time in this "gap region".

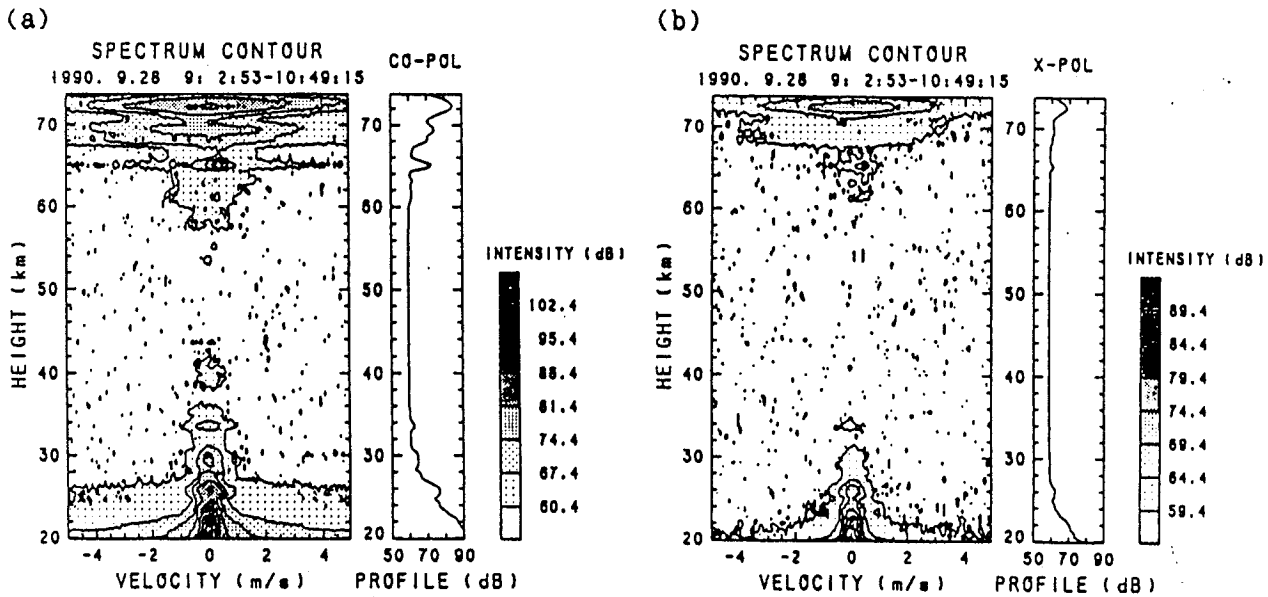


Fig.1 Spectrum contours received by (a) co-pol and (b) x-pol arrays.

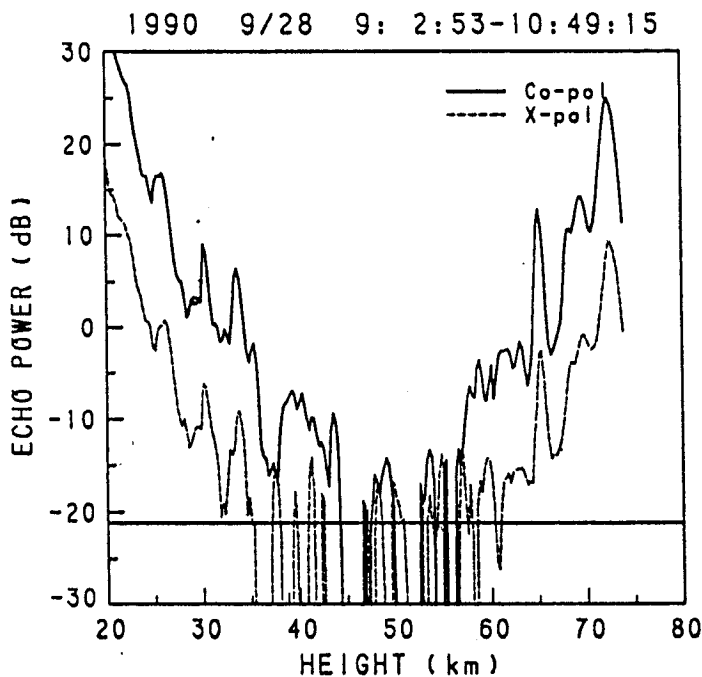


Fig.2 Height distribution of echo power for (a) co-pol and (b) x-pol components