IONOSPHERIC STUDIES AT THE JICAMARCA RADAR OBSERVATORY

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The Jicamarca Radar Observatory is located near Lima, Peru [11°57'S, 76°52'W, magnetic dip 2°N]. It consists of a 300 x 300 meter antenna (comprised of 9,216 crossed dipoles), several smaller antennas, 50 MHz transmitters and receivers, and digital sampling and processing equipment centered around a Harris S123 computer. The peak transmitted power is typically 1.5 MHz. Figure 1 shows a view of the incoherent scatter antenna. The beam of the main antenna can be steered to a limited degree by manually phasing the 64 sub-arrays. The sub-arrays can be operated independently or in various combinations. The allowable range of zenith angles includes directions perpendicular to the magnetic field. This is an special situation since the characteristics of the incoherent scatter signal change drastically when the angle of observations is directed perpendicular to the magnetic field. This also provides a rather unique capability for studying plasma irregularities associated with the equatorial electrojet and spread-F.

Presently, F-region vertical and east-west drift measurements are made on a regular basis. In addtion, electron density, and electron and ion temperatures can also be obtained. For the drift measurements the large antenna is split into two beams, both perpendicular to the magnetic field, one pointing 2.45° east of vertical, and the other pointing 4.33° west of vertical. The vertical and east-west drift components are then determined from the two radial drift measurements for altitudes usually between 200 and 700 km. The integration time is typically 1 min, the height resolution is about 15 km, and the estimated errors are about 1-2 m/s for the vertical drift and about 15 m/s for the zonal component. Further details of the Jicamarca drift measurement technique are given in Woodman and Hagfors [1969] and Woodman [1972]. These drifts have been used to infer the vertical and east-west electric fields [e.g., Fejer, 1981]. Recently, attempts have also been made for the measurement of north-south drifts, which are considerably more difficult to obtain at Jicamarca. The electron density measurements use the Faraday rotation method [Farley, 1969]. In this case a resolution of 10 km from 200 to 600 km in 3-5 min is easily achieved.

The geometry of the incoherent scatter radar and its low frequency of operation make it sensitive to structures much larger than the Debye length even at high altitudes. The relatively long probing wavelength make it very sensitive to turbulent fluctuations. Backscatter observations of F-region irregularities have provided decisive evidence for their identification with a nonlinear development of a gravitational (Rayleigh-Taylor) instability [Woodman and LaHoz, 1976], as well as for their triggering by atmospheric gravity waves [Kelley et al., 1981]. Figure 2 shows a Range-Time-Intensity plot of these irregularities, the plume-like features have been interpreted as the wake of one or many "bubbles" which have been convected up by unstable buoyancy. The Doppler spectra of these 3-m irregularities have been measured extensively at Jicamarca [e.g., Woodman and LaHoz, 1976]. In addition, radar interferometer observations can be used to determine the power, Doppler spectra and east-west drift motion of these waves [e.g., Kudeki et al., 1982].

The Jicamarca Radar can be used for a number of joint studies with the San

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Marco satellite. This could include the comparison of high temporal and spatial resolution vertical and east-west plasma drifts obtained at Jicamarca with the satellite measurements near Peru. During periods of spread-F these observations can be used to determine the relationship between the ambient plasma drifts and the irregularities drifts, and should also shed some light into the different kinds of bubbles observed at Jicamarca. Spread-F echoes are usually observed from September to March, and are most common between November and January. In addition, the north-south drift measurements at Jicamarca can be compared with the satellite north-south wind data. This comparison will be particularly important during periods of Spread-F when drift measurements cannot be made with the incoherent scatter technique. The height profiles of temperature and electron density obtained at Jicamarca together with the in-situ data should provide important new information on these parameters. The study of these topics is being proposed by a number of researchers. However, since the extended use of the high powered transmitters is costly, additional funding will be necessary for an effective use of the radar for these joint studies.

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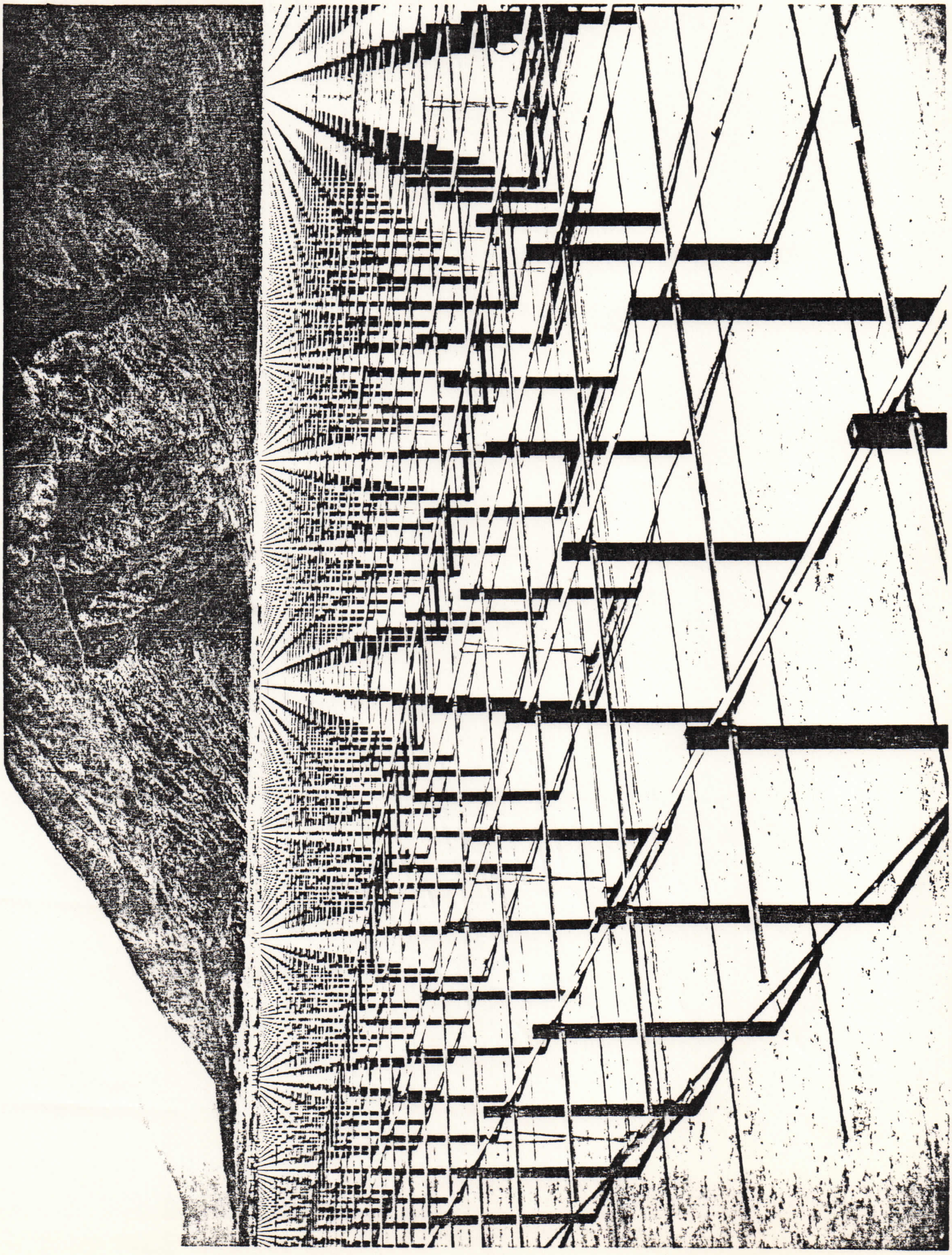

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