2.6B ORIGIN OF REFRACTIVE INDEX FLUCTUATIONS IN THE MESOSPHERE AS OPPOSED TO THE STRATOSPHERE AND TROPOSPHERE

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Mesospheric echoes are strongly influenced by the electron-density profile of the ionospheric D region (e.g. ECKLUND and BALSLEY, 1981). These echoes therefore are only observed during daylight hours or high-energy particle precipitation. The turbulence occurs in layers, which often confines the radar echoes to rather thin regions of several 100 m vertical extent, although layers as thick as several kilometers were also obeserved. However, it never was found with high-resolution radars that evaluable echoes were observed through the entire altitude region of the mesosphere for the given power aperture product $5 \cdot 10^7 W\ m^2$. Additionally, the echoes indicate quite some temporal variation.

To illustrate the evident temporal and spatial variation, a contour plot of signal strength is presented in Figure 1 (from ROTTGER et al., 1983). In the mesosphere four separated regions of turbulence scatter were detected after 1200 AST between 65 and 78 km altitude. At 1215 AST a noise burst was observed, followed by an abrupt increase of signal strength of turbulence scatter. The noise burst was due to enhanced solar radio emission during an H_α solar flare. The enhanced noise level must have been picked up through an antenna sidelobe pointing to the sun. The simultaneously increased flux of UV and X-ray radiation also resulted in an enhancement of the D-region electron density which caused sudden increase of turbulence scatter strength by some ten dB. Simultaneous incoherent-scatter observations with the 430-MHz radar showed an increase of the mean D-region electron density by a factor of 5-8 (personal communication from J. Mathews and M. Sulzer, 1981). However, even the abnormally high electron density still did not yield a continuous power profile of turbulence scatter. The reason is that the mesosphere was not totally turbulent, but the turbulence was confined to intermittent layers. In Figure 2 height profiles of average power measured before and after the solar flare are shown as well as the power difference P_2-P_1 in dB. It is well recognized that the power scattered due to mesospheric turbulence had increased by up to one order of magnitude. These observations show that a sudden increase or even moderate variation of signal strength of mesospheric VHF radar echoes cannot at all be attributed to an increase of turbulence strength, but rather an enhancement ot electron density or electron-density gradient.

REFERENCES

Ecklund, W., and B. Balsley (1981), Long-term observations of the arctic mesosphere with the MST radar at Poker Flat, Alaska, J. Geophys. Res. 86, 7775-7780.

Rottger, J., P. Czechowsky, R. Ruster and G. Schmidt (1983), VHF radar observations of wind velocities at the Arecibo Observatory, J. Geophys. Res., 52, 34-39.

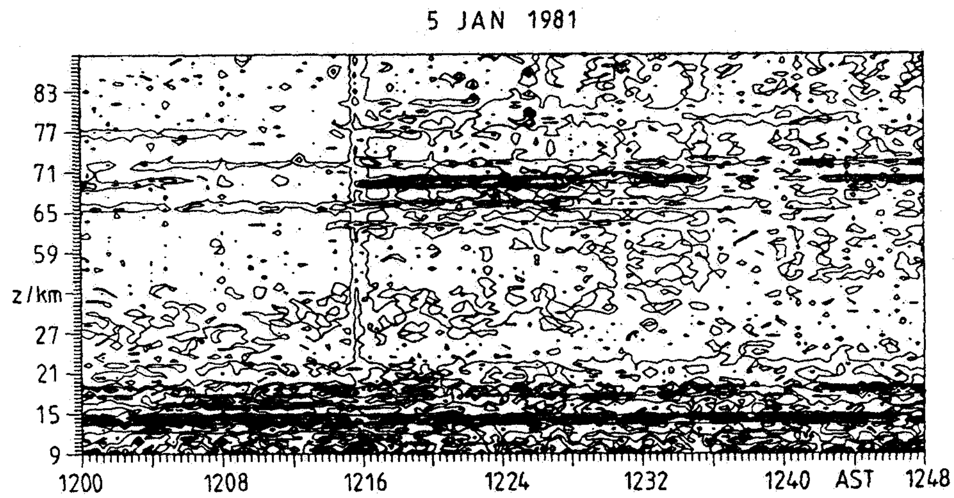

Figure 1. Contour plot of received power (signal + noise) as a function of height z and time (AST = Atlantic Standard Time). The power difference between the contour lines is 2 dB. Because atmospheric signals were not received in the height range 33-53 km, this range is suppressed in the plot. Measurements were carried out at the Arecibo Observatory with a 46.8-MHz radar with peak power of 30 kW and antenna beam pointing at a zenith angle of 2.7°.

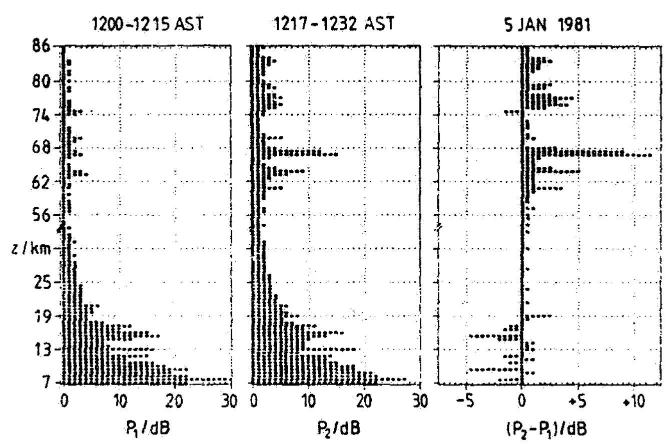

Figure 2. Profiles of average power measured before (P_1) and after (P_2) the solar flare, and power difference P_2-P_1 in dB.