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J. Röttger and R.F. Woodman

MAX-PLANCK-INSTITUT FÜR AERONOMIE

VHF-Radar Observations of Layered Structure of the Equatorial Spread-F: Implications to the Spatial Resonance Effect

J. Röttger and R.F. Woodman
Max-Planck-Institut für Aeronomie
D-3411 Katlenburg-Lindau 3, F.R.G.

Recently the spatial resonance mechanism of gravity waves and plasma drifts was assumed to be responsible for the modulation of the macro-scale structure of the equatorial spread-F (Beer, 1974; Röttger, 1976a). To check this idea, RTI-records of the Jicamarca radar (Woodman and La Hoz, 1976) which indicate quasi-periodic layers of spread-F irregularities were evaluated.

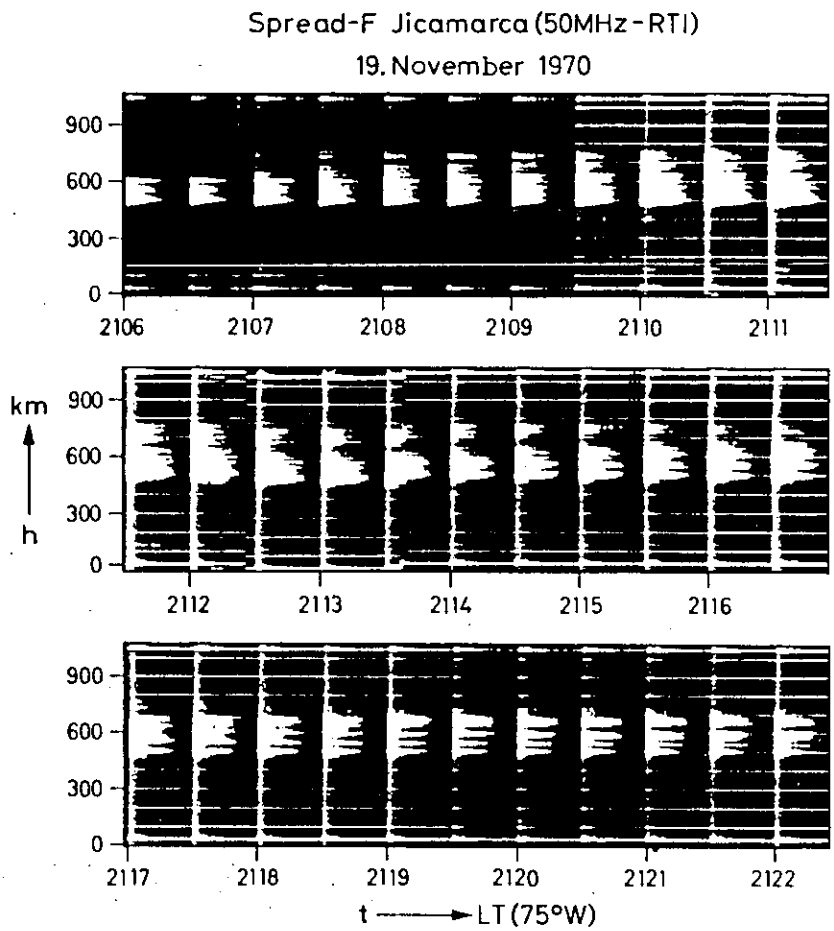

Fig. 1 RTI-records showing quasi-periodic striated layers of spread-F irregularities.

A split of the F-region into structured layers during spread-F conditions is also observed with ionosondes. The occurrence of satellite traces on the ionograms (Clemesha and Wright, 1966), which is an indication of range-type spread-F, is shown in Fig. 2, comparing ionosonde data from Huancayo with VHF-radar data from Jicamarca. It has to be taken into account that the radar detects the vertical structure of irregularities, whereas the ionosonde is sensitive to oblique reflections which are caused by horizontally stringed irregularity patches. However, Fig. 2 indicates a significant correlation between both observations, which directs attention to the correspondence of the spread-F activity in the horizontal and vertical plane.

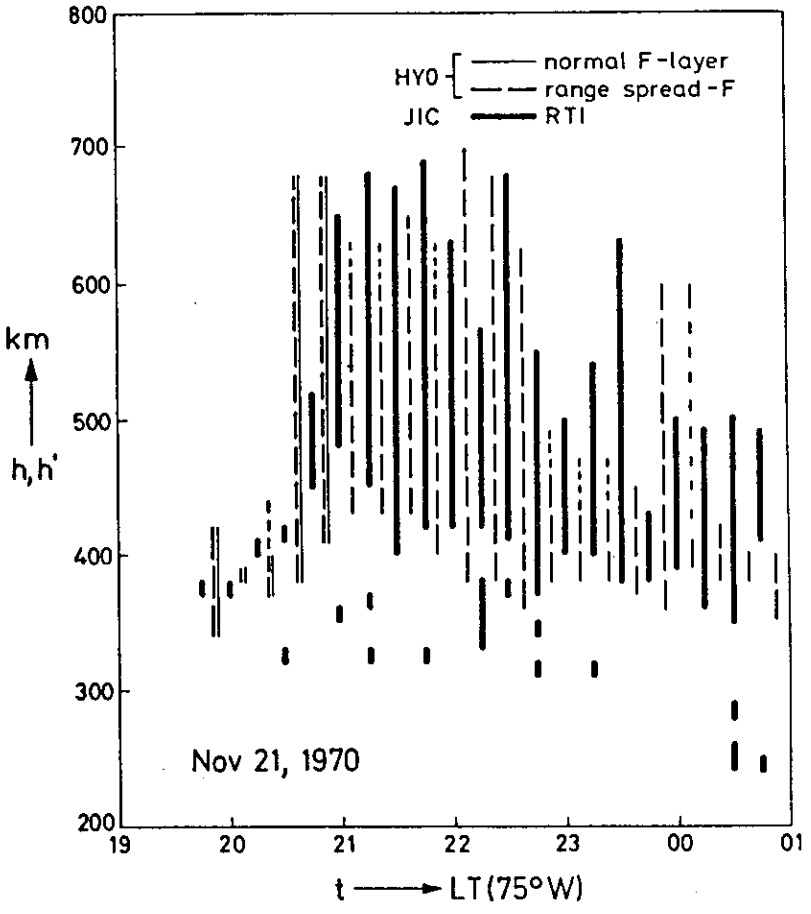

Fig. 2 Comparison of spread-F observed with the ionosonde in Huancayo (HYO) and the VHF-radar in Jicamarca (JIC-RTI). The radar measures the height h of irregularities whereas the ionosonde measures the virtual range h'.

Some considerations of Röttger (1975) and the regular occurrence of medium-scale TIDs in the equatorial region (Röttger, 1976b,c) show that the horizontal wave-like structure of spread-F patches can be caused by the spatial resonance mechanism (Beer, 1974). The question was examined if the quasi-periodic layers observed with the Jicamarca radar document the vertical wavelength of gravity waves, respectively of TIDs, giving rise to the resonance mechanism.

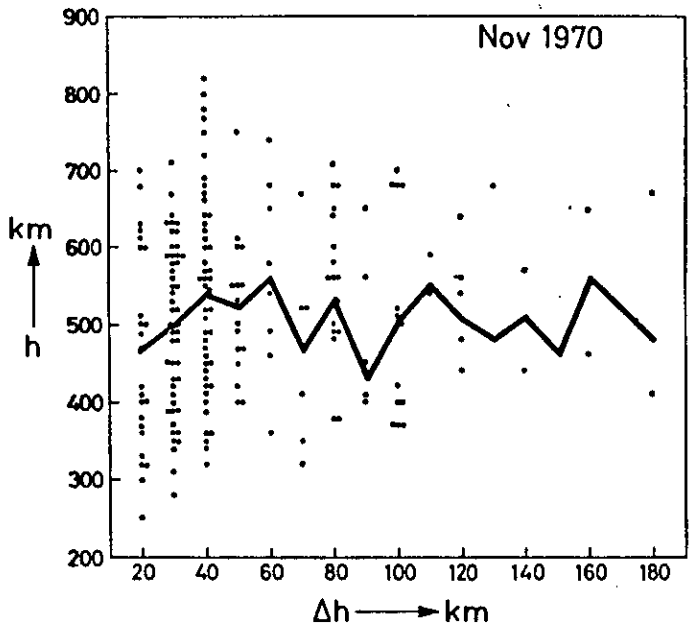

Fig. 3 Separation Δh of layers of spread-F irregularities as a function of height.

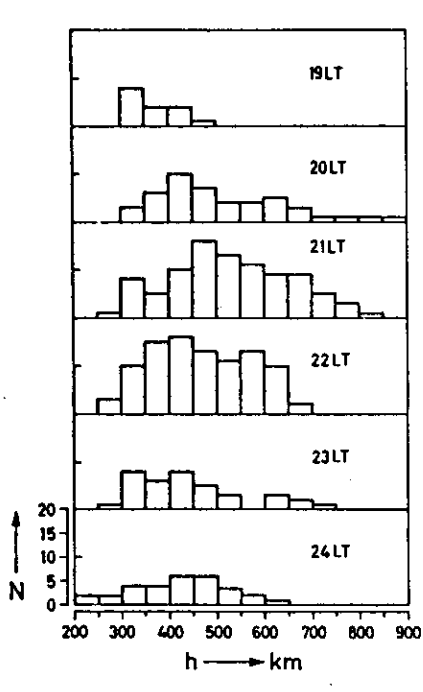

Fig. 4 Distribution of striated spread-F layers as a function of height and time (RTI-data from November 1970, 1971, 1972). N gives the number of different layers found during one hour observation time in the respective height interval of 50 km.

Statistical evaluations of RTI-data indicate that the mean vertical separation of the striated spread-F layers is about 50 km and does not show a significant height dependence (Fig. 3). Since the vertical wavelength of gravity waves in the thermosphere increases strongly with height (Klostermeyer, 1972), we suppose that the layered structure of spread-F irregularities observed at heights above the F-layer maximum does not originate in the resonant modulation due to gravity waves. On the other hand, Fig. 4 shows that these striated layers occur at heights around 800 km, which is the maximum height where TIDs were observed (Thome, 1968).

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References

Beer, T. 1974 On the dynamics of equatorial spread-F. Australian Jour. Phys., 27, 391-400.

Clemesha, B.R. Wright, R.W.H. 1966 A survey of equatorial spread-F. AGARDograph, 95, 3-27.

Klostermeyer, J. 1972 Influence of viscosity, thermal conduction and ion drag on the propagation of atmospheric gravity waves in the thermosphere. Zeitschr. Geophys., 38, 881-890.

Röttger, J. 1975 Entwicklungsphasen des äquatorialen Spread-F. Kleinheubacher Berichte, 18, 355-366.

Röttger, J. 1976a The macro-scale structure of equatorial spread-F irregularities. Jour. Atmos. Terr. Phys., 38, 97-101.

Röttger, J. 1976b Travelling-Ionospheric-Disturbances in der Äquatorzone. Kleinheubacher Berichte, 19, 443-453.

Röttger, J. 1976c Traveling ionospheric disturbances in equatorial regions observed with groundbackscatter and Doppler measurements of HF-waves. Conference Digest 5th ISEA (this issue).

Thome, G. 1968 Long-period waves generated in the polar ionosphere during the onset of magnetic storms. Jour. Geophys. Res., Space Phys., 73, No. 19, 6319-6336.

Woodman, R.F. La Hoz, C. 1976 Radar observations of F-region equatorial irregularities. Jour. Geophys. Res. (in press).