

LETTERS TO THE EDITOR

EQUATORIAL SPREAD-F CONFIGURATIONS AND MAGNETIC ACTIVITY

THE morphological characteristics of equatorial spread-F have been extensively studied over the past two decades using published ionospheric data bulletins (Clemesha and Wright¹ and Skinner and Kelleher², for earlier work). However, these investigations suffer from the drawback that they do not take into consideration, the type of spread-F, as this is not given in the published data. A better approach that is now being adopted³⁻⁵ is the direct use of ionograms, usually quarter-hourly, for the study of equatorial spread-F.

Spread-F on equatorial ionograms usually manifests in two forms: range spread or equatorial type spread-F and frequency spread or temperate latitude-type spread-F. Range spread-F on ionograms is characterised by a general widening and diffusion of the F layer trace over the entire frequency range at which echoes are seen while in frequency spread-F the widening and diffusion of the trace is present at frequencies at and around the critical frequency (f_oF^2). The mechanisms responsible for the origin of these two types of equatorial spread-F are considered to be different¹. Recently King⁶ claimed that spread-F, in general (including equatorial spread-F), is not due to partial reflection from irregularities but due to total reflection from rather sharp tilts in the isoionic contours and that frequency spread-F is the decay product of range spread-F. However, Skinner and Kelleher² argue that although oblique reflections from inclined isoionic contours could lead to a broadening of the F layer trace, it is not a major factor in producing equatorial spread-F. A very recent study made by us on equatorial spread-F configurations using quarter-hourly ionogram data of Kodaikanal for a six year period (1964-69) showed that both the range and the frequency spread-F configurations show a positive correlation with solar activity and the occurrence patterns of the same show a significant similarity⁶. In view of this observation, we further investigated another aspect of equatorial spread-F configurations, *i.e.*, their occurrence in relation to magnetic activity, using quarter-hourly ionogram data of Kodaikanal (Geomag. Lat. 0.6° N; Dip 3.5°), the results of which are present in this brief communication.

To investigate the dependence of the occurrence of the two types of spread-F configurations on magnetic

activity, days in each month for the entire period (January 1964-December 1969) are divided into those of quiet and disturbed depending on whether AP (magnetic character figure) is ≤ 5 or ≥ 15 respectively. This approach is followed in deviation to the alternative, often used, one of considering the "International Quiet" and 'disturbed' days in each month, as an 'International Quiet day' in some months may only be equal to a 'disturbed day' in other months. For each month, the quarter-hourly ionogram data of Kodaikanal for the two sets of days are examined for the presence of either of the two types of equatorial spread-F configurations. It is to be pointed out here that the rather unusual forms of spread-F that are known to exist on equatorial ionograms³⁻⁵ are not taken into consideration in this study. From these data, the monthly percentage of each type of spread-F configuration is evaluated separately for both quiet and disturbed days. Median values of sunspot number corresponding to the quiet and disturbed days have also been obtained for each month. Running averages were then calculated to smooth out short term and seasonal variations. In Fig. 1 is shown the variation

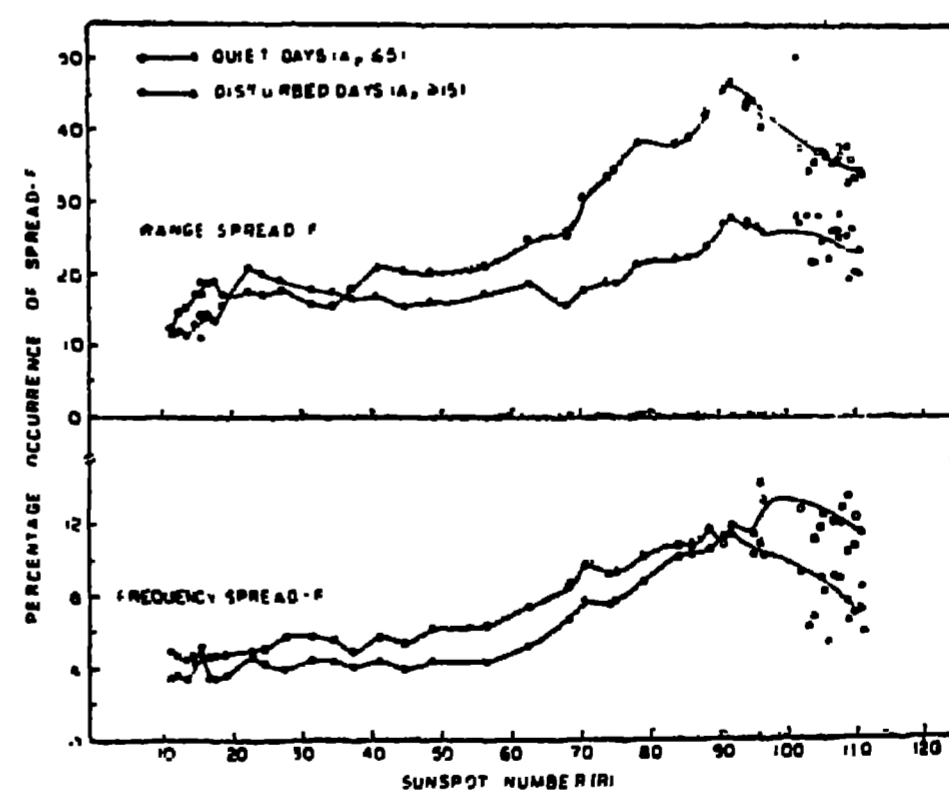


FIG. 1. Variation of percentage occurrence of range and frequency spread-F with sunspot number for quiet ($A_p \leq 5$) and disturbed ($A_p \geq 15$) conditions at Kodaikanal for the period 1964-69.

of the percentage occurrence of both the range and the frequency spread-F configurations with sunspot number, for quiet and disturbed days. It can be clearly seen from Fig. 1 that the effect of increased magnetic activity is to reduce the occurrence of

both range and frequency spread-F and this feature is more evident during moderate solar activity periods ($R_s > 100$) than during low solar activity periods ($R_s < 20$). This result differs from the work of Chandra and Rastogi⁷ who reported that frequency spread-F does not exhibit significant reduction due to magnetic disturbances.

The above finding coupled with our earlier observations⁶ on equatorial spread-F configurations suggest that the most common forms of equatorial spread-F may be due to a same causative mechanism, as the statistical behaviour (dependence on solar activity, magnetic activity and monthly occurrence pattern) of the two types are found to be very similar.

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1. Clemesha, B. R. and Wright, R. W. H., *Spread F and its Effects upon Radio Wave Propagation and Communications*, (Ed. P. Newman), Technivision, England, 1966, p. 3.
 2. Skinner, N. J. and Kelleher, R. F., *Ann. Geophys.*, 1971, **27**, 181.
 3. Chandra, H. and Rastogi, R. G., *Ibid.*, 1972, **28**, 37.
 4. Sastri, J. H. and Murthy, B. S., *Ibid.*, 1975 (in press).
 5. King, G. A. M., *J. Atmosph. Terr. Phys.*, 1970, **32**, 209.
 6. Sastri, J. H., Murthy, B. S. and Sasidharan, K., *Ann. Geophys.*, 1975 (in press).
 7. Chandra, H. and Rastogi, R. G., *Ibid.*, 1972, **28**, 709.
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