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F-LAYER CONTRIBUTION TO MF NIGHT-TIME SKY WAVE IN SHORT DISTANCE

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Even in the range of short distance near and within the skip zone, contribution from the propagation fields through the ionospheric F-layer at the night time may not be neglected but it becomes dominant contribution. This may be utilized in the calculation of the interference effects due to closely located broadcasting stations in the night time.

Sky wave contribution in the band of medium frequency and its propagation curves have mostly been studied experimentally. Theoretical work on this contribution appeared to be concerned mainly with the long distance prediction more than 1,200 Km, for which ionospheric E-layer contribution appears to be sufficient for the prediction of the propagation fields in the night time hours. Kinase and Knight's wave hop method (1) in the calculation of E-layer contribution may be modified for the calculation of the F-layer contribution. The F-layer contribution to the night time medium frequency sky wave field is calculated numerically by modifying Jones' computer program of ray tracing(2), where various necessary physical assumptions are made on the transmitting, receiving and ionospheric conditions such as antenna patterns, conductivity of the ground, receiving angles, polarization coupling, and ionospheric absorption.

The foregoing numerical calculations are compared with the experimental data, annual averages of median values measured by Sawamura(3) for eight radio broadcasting stations in Japan. Measurements were taken in an isolated wooden house containing practically no metallic materials and for a whole year, two hours everyday after sunset at Tokyo. Results accounting for the F-layer contribution closely predict the measured values, as shown in the table 1 and Fig.1, within the measurements error range (standard deviation), which is about 6dB maximum.

References

(1) A. Kinase, "Night-Time Sky-Wave Propagation of Radio Waves in Band 6 (MF), Parts I and II, Report for the ITU Seminar on the Planning of Broadcasting Systems, Jakarta, Nov. 1973

(2) R. M. Jones, "Modification to the Three Dimensional Ray Tracing Program Described in IERI7-ITSA17,ESSA Technical Memorandum ERLTM-ITS 134, ESSA Research Lab., Institute for Telecommunication Sciences, Boulder, Colorado, April 1968

(3) E. Sawamura, Night-Time Field Strength of the Medium Frequency Radio Waves, Japan Broadcasting Corporation, Technical Research Lab., May 1960

Table 1. Measured and calculated fields

Radio station	Sendai A	Sendai B	Osaka	Matsue	Hiro-shima	Fuku-oka	Kuma-moto	Kitami
Carrier frequency(KHz)	890	1430	890	1110	1050	550	1150	980
Antenna length (m)	56	48	157	130	137	54	46	55
Ant. efficiency	0.42	0.456	0.76	0.765	0.442	0.575	0.562	0.541
Distance from receiver (Km)	315	315	389	611	663	870	871	1006
Longitude of the station (degree)	140.9	140.9	135.4	133.0	132.3	130.3	131.7	144.2
Latitude of the station (degree)	38.3	38.3	34.7	35.6	34.4	33.7	32.8	44.0
Azi. transmission angle respect to geomeridian (deg.)	191.2	191.2	72.2	89.9	80.9	77.5	71.2	201.7
Measured field strength (dB to 1μV/m)	46.4	46.9	42.3	43.6	41.0	38.0	39.0	37.0
Calculated total field strength (dB to 1μV/m)	40.9	41.4	42.3	45.6	43.5	43.0	40.5	41.0

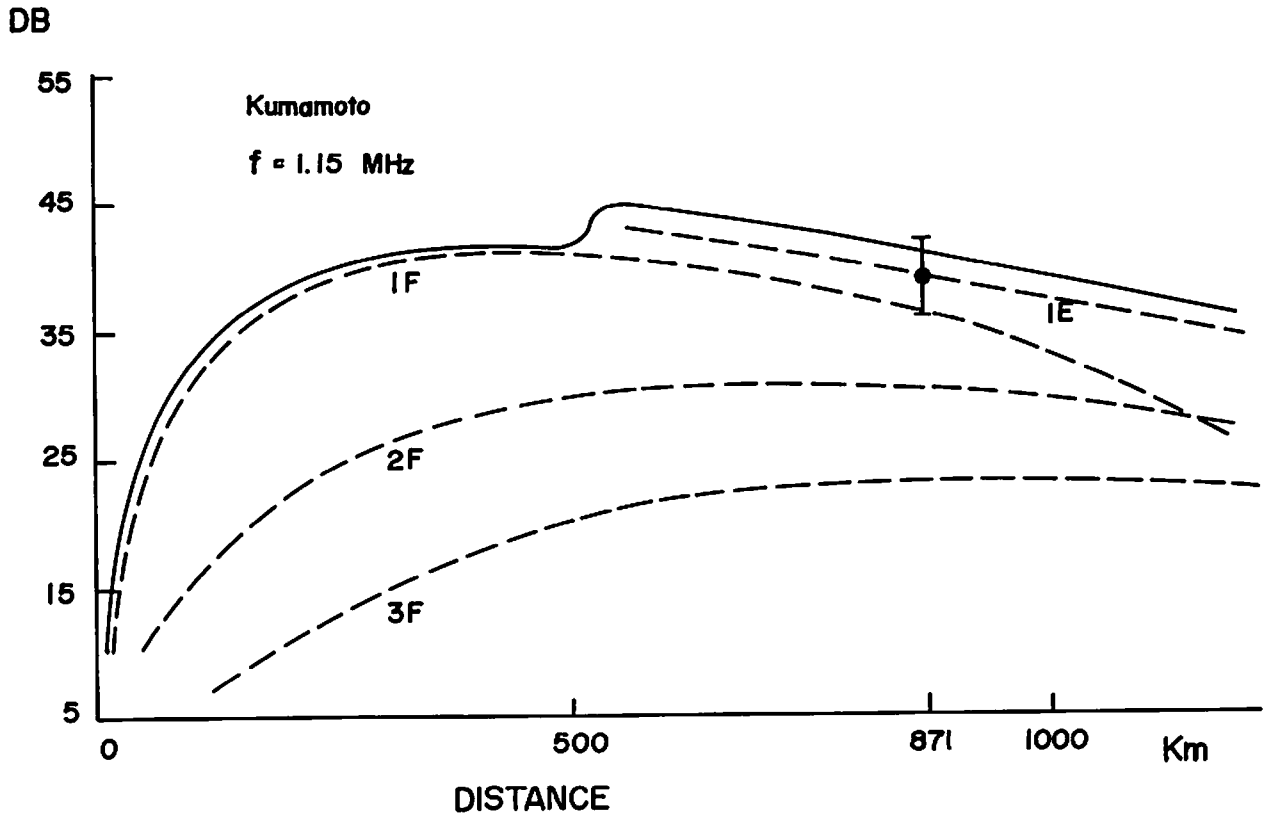

FIG. 1 TOTAL FIELD INTENSITY