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PREDICTIONS OF NORMAL RADIO CRITICAL FREQUENCIES RELATED TO SOLAR ECLIPSES IN 1940

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ABSTRACT

The ordinary-wave critical frequencies of the E, F_1, F_2, and night F layers are predicted for use in ionospheric eclipse observations during the annular solar eclipse of April 7, 1940, and the total solar eclipse of October 1, 1940. The probable reliability and range of application of the data are discussed.

In connection with preparations for ionosphere observations during the solar eclipses of April 7 and October 1, 1940, it is of interest to know the average values of the normal critical frequencies which may be expected in the paths of the eclipse. It is the purpose of this note to give estimates of the expected average values of the ordinary-wave critical frequencies of the E, F_1, F_2, and night F layers.

The annular eclipse of April 7 will be observable in northern Mexico and the southern United States. Figure 1 gives the estimated monthly average critical frequencies for a place in Texas 29° N and 100° W for that month. Figure 2 gives the estimated values for Washington, D. C., for the same month. All predictions are given in terms of monthly averages, and the hours are local times at the given places. The Washington values were obtained by the same procedure as that used in preparing the monthly predictions published in the Proceedings of the Institute of Radio Engineers [1].[1] The Texas values were estimated by interpolating between the Washington data and the data for Huancayo, Peru, [2] 12° S and 75° W, for the same season. The graphs for Texas may be used for other locations in the United States in the path of the eclipse.

The total eclipse of October 1 will be observable in northern South America and in South Africa. Figure 3 gives estimated monthly average critical frequencies for Huancayo, Peru, 12° S and 75° W, for this month. These values may be considered as representative of the values to be encountered in northern South America. Figure 4 gives estimated monthly average critical frequencies for Watheroo, Western Australia, 30° S and 116° E, for October. It is believed that these values may be used for the South African location at approximately the same geographic latitude, although, owing to the differences in longitude and magnetic latitude, they may not be as reliable. The data of figures 3 and 4 were obtained by the same procedure as for Washington, using the available published data for Huancayo [2] and Watheroo [3].

[1] Figures in brackets indicate the literature references at the end of this paper.

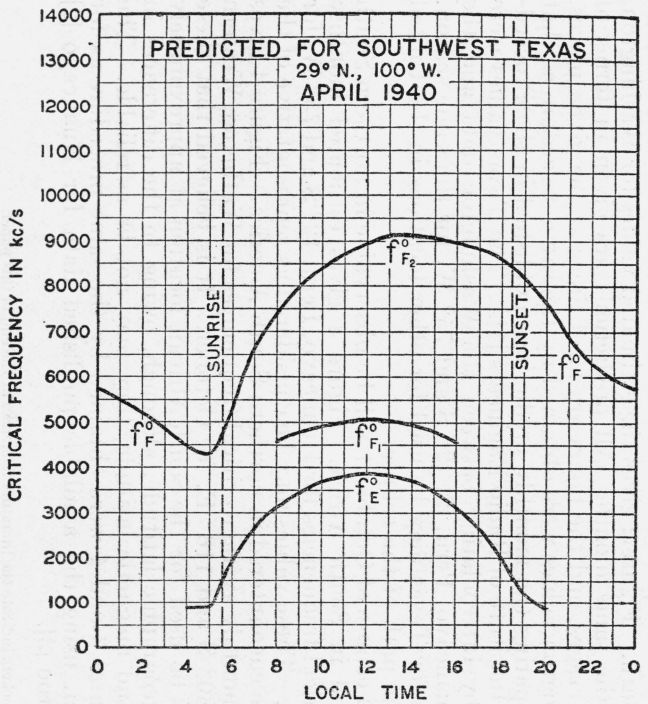

FIGURE 1.—*Predicted average critical frequencies of the E, F_1, F_2, and night F layers for undisturbed days in April 1940, for a place in Texas 100° W and 29° N.*

Abscissas are local times. These graphs may be used in northern Mexico or at other places in the southern United States whose latitudes are not much different from 29° N.

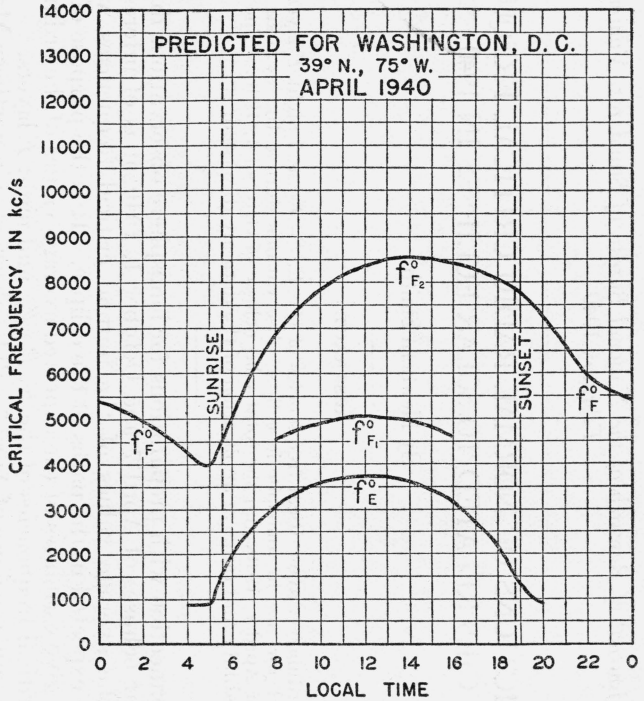

FIGURE 2.—*Predicted average critical frequencies of the E, F_1, F_2, and night F layers for undisturbed days in April 1940, for Washington, D. C.*

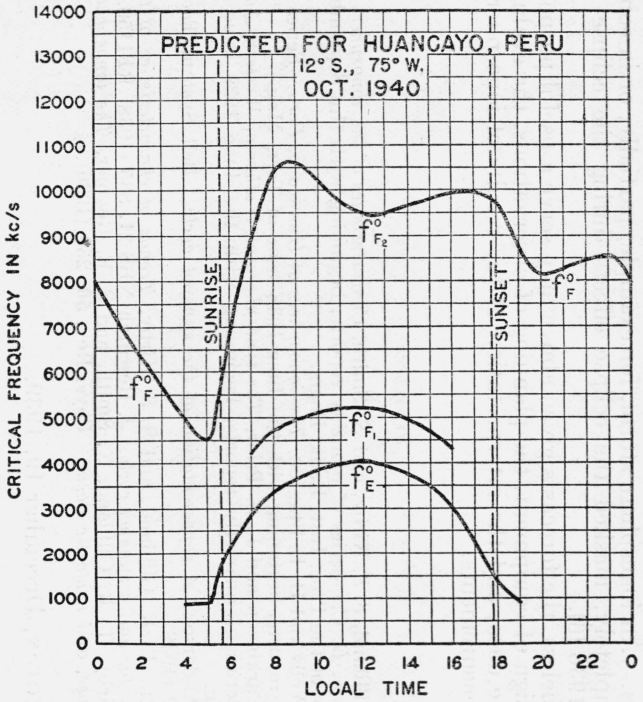

FIGURE 3.—*Predicted average critical frequencies of the E, F_1, F_2, and night F layers for undisturbed days in October 1940, for Huancayo, Peru, 75° W and 12° S.*

Abscissas are local times. These graphs may be used for places in northern South America whose latitudes do not differ greatly from 12° S.

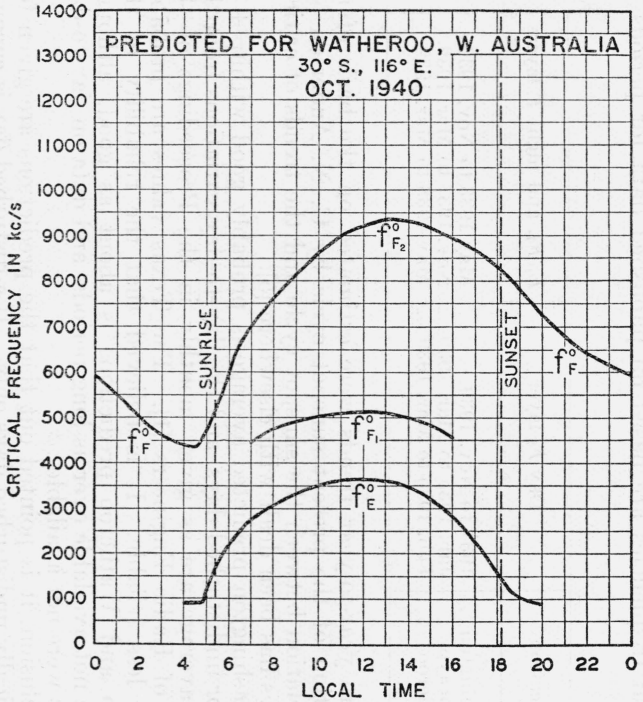

FIGURE 4.—*Predicted average critical frequencies of the E, F_1, F_2, and night F layers for undisturbed days in October 1940, for Watheroo, Western Australia, 116° E and 30° S.*

Abscissas are local times. These graphs may be used for places in South Africa whose latitudes do not differ greatly from 30° S.

The diurnal and seasonal variations and the year-to-year trends of the critical frequencies are based on published data for periods as follows:

Location	Day F_2 layer	E, F_1, and night F layers
Washington	1931 to Nov. 1939	May 1933 to Nov. 1939.
Huancayo	Jan. 1935 to Mar. 1939	Nov. 1937 to Mar. 1939.
Watheroo	Feb. 1935 to Mar. 1939	May 1938 to Mar. 1939.

The future year-to-year trends were estimated on the basis of an extrapolation of the present sunspot cycle by C. N. Anderson [4]. The correlation between the sunspot cycle and the trends of critical frequencies has been dealt with elsewhere [5].

The Washington predicted average is probably good within ± 15 percent for undisturbed days, and the day-to-day variations from the monthly average are as given monthly in the Proceedings of the Institute of Radio Engineers [1]. The Texas values are probably but little less reliable. It is believed that the reliability of the Huancayo and Watheroo predictions is about as good, although data were not available over as long periods, and data on day-to-day variations were not available.

In conclusion, it is pointed out that the predictions are given for ionospherically undisturbed days only. If a disturbed day is encountered, the values observed may differ widely from the estimates, the difference being greater the nearer the observer is to one of the magnetic poles. An ionosphere storm, for example, partially, or in some cases completely, masked the eclipse effects during the eclipse of June 19, 1936 [6].

Nevertheless, the forecasts given above may serve a useful purpose in the design of equipment, the planning of observations, the evaluation of the data, and the interpretation of the results of ionospheric eclipse measurements.

References

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[2] H. W. Wells and H. E. Stanton, *The ionosphere at Huancayo, Peru.* Series of quarterly reports, beginning with the June 1938 issue of Terr. Mag.

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[4] C. N. Anderson, *A representation of the sunspot cycle.* Bell System Tech. J. **18,** 292 (1939).

[5] N. Smith, T. R. Gilliland, and S. S. Kirby, *Trends of characteristics of the ionosphere for half a sunspot cycle.* J. Research NBS **21,** 835 (1938) RP1159.

[6] S. S. Kirby, T. R. Gilliland, N. Smith, and S. E. Reymer, *The ionosphere, solar eclipse, and magnetic storm.* Phys. Rev. **50,** 258 (1936).

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