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Ionospheric Effects During February 1980 Solar Eclipse

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Abstract

Highlights of the ionospheric effects of the total solar eclipse of February 16, 1980 detected by ground-based experiments in India are summarised. Decrease in electron density at various heights in ionosphere upto the F_2 layer peak over Ahmedabad was associated with the eclipse, the decrease being gradually delayed at higher heights. Similar decrease was noted from the total electron content derived from the Faraday rotation measurements made at a few stations using the 136 MHz radio beacon from ETS-II satellite. Polarization scintillations were seen on all nights except the eclipse night.

A total solar eclipse provides a rare opportunity to study the interaction of solar radiation on the Earth's upper atmosphere. With the opportunity of a total solar eclipse of February 16, 1980 in India, the Physical Research Laboratory, Ahmedabad conducted a variety of ground-based and in-situ rocket-borne experiments spread over different locations in India in collaboration with Space Applications Centre (Ahmedabad), Sriharikota Range (Sriharikota), Vikram Sarabhai Space Centre (Trivandrum), Saurashtra University (Rajkot), University of Pune (Pune), Osmania University (Hyderabad), and Jamal Mohamed College (Tiruchirapalli). The details of the experiments conducted have been reported earlier (Deshpande 1980). Here a few results of the ground-based experiments are reported. These include the ionosonde operated at Ahmedabad, Faraday rotation measurements at 136 MHz radio beacon using the geostationary satellite ETS-II at Ahmedabad, Rajkot, Pune and Rangapur, and amplitude scintillations recorded at Ahmedabad, Rangapur and Tiruchirapalli.

The ionosonde at Ahmedabad was operated continuously from a few hours before to a few hours after eclipse on February 16, 1980. The characteristics of different ionospheric layers will be reported elsewhere. Here we present the electron density distributions with height from 13 hr LT (75°EMT) to 17 hr LT on eclipse day (February 16, 1980) and on a control day (February 17, 1980) based on the reduction of quarter hourly ionograms using Budden's matrix method. The variations with time of electron density at different fixed true heights starting from 160 km, are shown in Figure 1. The thick line at top is N_{max}. Gradual decrease in electron density is noted soon after the starting time of the eclipse and minimum is noted at the maximum of eclipse. The eclipse effects at lower heights are matched with the obscuration exactly, while at higher heights there is a gradual delay when the effects are seen. The minimum is around 15.15 hr LT at 160 km and around 15.50 hr LT at 360 km. Magnitude-wise, the decrease in electron density is around 40% at 160 km and around 25% at 360 km.

The total electron content (TEC) derived from the Faraday rotation measurements made at Ahmedabad on February 16 and 17 1980 are shown in Figure 2 from quarter hourly calculations. Similar features are seen at Rajkot, Pune and Rangapur also. Therefore, results at Ahmedabad only are shown here. The TEC on 16th is comparatively smaller than that on 17th. This is probably because of a magnetic storm which occurred on February 14. There is a wavy structure in the variation of TEC on February 16. However, the second dip at 15.30 hr is associated with the eclipse effect (minimum at 15.30 hr is noticed at all the stations). Further, from the N (h) profiles, the minima were found to be at 15.15 to 15.50 hr at different heights. Hence, minimum at 15.30 hr is logical due to the integrated effect, which will be seen in TEC. There is no evidence of eclipse induced gravity waves from these observations. Fluctuations with periods of 15-20 minutes are generally observed in eclipse induced gravity waves (Davis and daRosa 1970; Vaidyanathan et al. 1978).

The observations of Faraday rotation angle (polarization) were carried out continuously for two weeks beginning a week before the eclipse. Polarization scintillations were observed on all nights except the eclipse night at all the stations. Figure 3 shows the records at Rajkot.

References

Davis M.J. and daRosa A.V. 1970, *Nature*, **226,** 1123.

Deshpande M.R., 1980, *Report on Scientific Objectives of the Total Solar Eclipse* 16 *February* 1980, Physical Research Laboratory, Ahmedabad.

Vaidyanathan S., Raghava Reddi C. and Krishnamurthy B.V. 1987, *Nature*, **271,** 41.

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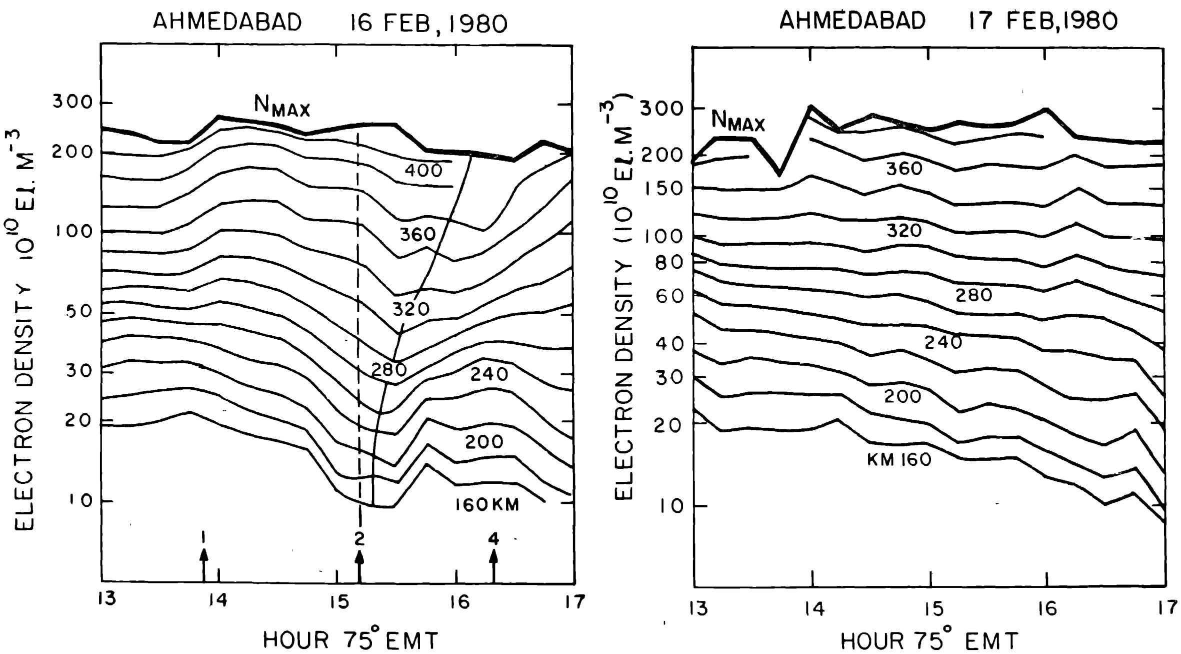

Fig. 1: Variations of the electron density at fixed real heights over Ahmedabad (a) on February 16, 1980 and (b) on a control day, February 17, 1980. The arrows with markings 1, 2, and 4 in Fig. 1 a represent the times of start, the maximum obscuration, and the end of eclipse respectively.

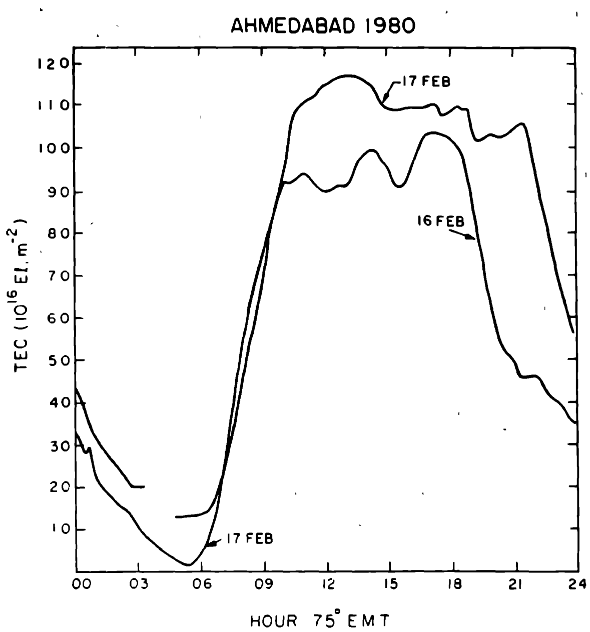

Fig. 2: Daily variations of the total electron content derived from Faraday rotation measurements made at Ahmedabad using 136 MHz radio beacon from ETS-II satellite on February 16 (eclipse day) and February 17 (control day).

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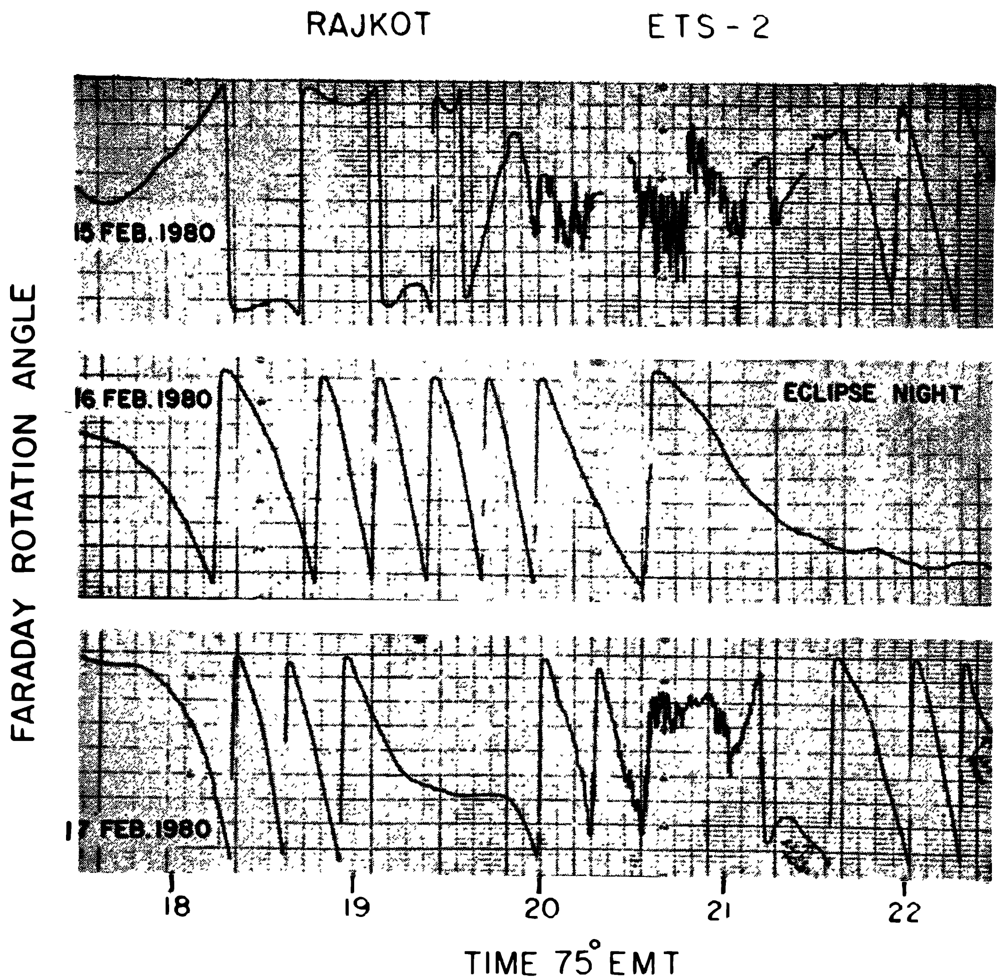

Fig. 3: Example of the polarization scintillations at 136 MHz using radio beacon from satellite ETS-II and recorded at Rajkot. Note no scintillations were present on the eclipse night.

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