Kodaikanal Obs. Bull. (1997) 13, 193-196

Effect of the Solar Eclipse of October 24, 1995 on the Ionospheric F-region over Kodaikanal

D. Karunakaran
Indian Institute of Astrophysics, Bangalore 560 034

Abstract

High time resolution soundings of the ionosphere over Kodaikanal were made with the IPS - 42 Digital Ionosonde on 24 October 1995 and on several days prior to and after that. The ionogram data were used to study the effect of the Solar eclipse on the structure and dynamics of the F-region plasma over Kodaikanal in the penumbral zone. Preliminary results of the data analysis are presented.

Key Words : Solar eclipse, Ionosphere, Magnetosphere, Electron density, F-region dynamics

Introduction

The occurrence of solar eclipse has its effects locally and widely over different levels of terrestrial lower atmosphere, ionosphere and the magnetosphere. The changes in the ionization in ionosphere lead to perturbations in electron density, electrical conductivity and hence cause variations in magnetic field and motions in the ionospheric layers.

In order to investigate the effect of the solar eclipse on the ionosphere over Kodaikanal (Long : 77.5° E Lat: 10.2° N) under the penumbral region of the shadow cone of the moon, intensive observation schedule was programmed for vertical incidence radio soundings with IPS - 42 Digital ionosonde. Five minutes interval ionograms were collected for five days before and five days after the day of eclipse. Ionograms at one minute interval were recorded during the eclipse. The ionograms were scaled to get the values of h'F, critical frequency (f_0F_2), virtual height at every one MHz and (M3000) F_2 (Maximum usable frequency). The eclipse started at 0737 reached maximum one at 0841 and ended at 0953 IST at Kodaikanal.

Results

A preliminary study of the effects of the eclipse on the F-region has been carried out taking the 5 minutes interval values of the above parameters into account for the eclipse day

and the next day the 25 October 1995 one of the five international quiet days with kp 8 and Ap 4 while 24th was almost a quiet day with kp 16 Ap 10.

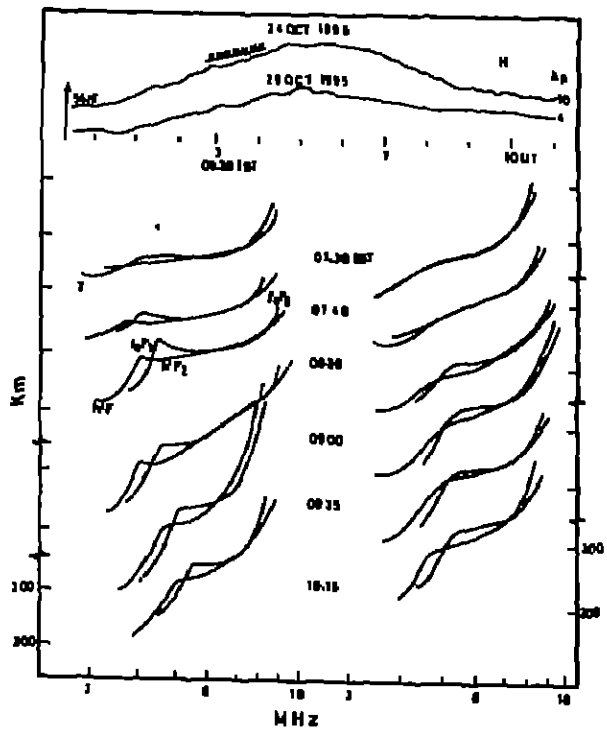

Figure 1 : Magnetographic traces of Horizontal component of Earth magnetic field on 24.10. '95 and 25.10.'95 and Ionogram traces (h'F curves) of F region over Kodaikanal on 24.10.95 and 25.10.'95.

Figure 1 shows the magnetogram traces of the Horizontal component of the Earth's magnetic field and traces of h-F curves of the F-region during the periods under consideration. It can be easily seen that the F-region has behaved in a different manner on the eclipse day than its behaviour on a quiet day. It is evident that a modification and redistribution of electron density with height had happened due to the eclipse. A small depression in 'H' is doubted around the period corresponding to the maximum phase may be due to cutting off of ionizing radiation from sun.

Figure 2 manifests the variations that took place in critical frequency foF2 (representing the maximum electron density) and in the height of maximum electron density (hmF_2) derived from the values of $(M3000)F_2$ during the time of Eclipse and their deviation from the control day values and monthly median values. There are positive and negative deviations and a large sudden negative departure after the maximum phase, suggesting that the effects developed during the course of the eclipse vanish by the end of eclipse. So it is clear that the F-region became greatly disturbed by addition and subsequent reduction in electron density modifying the distribution over the whole height range. The disturbance close to the end is a salient feature of the eclipse, associated with the changes in electric conductivity in the lower E-region.

In order to study the changes in virtual height with respect to electron density, the five minute values of the height of reflection of the frequencies from 4 MHz upto critical frequency from 0700 to 1200 hrs IST were plotted for the Eclipse day and control day.

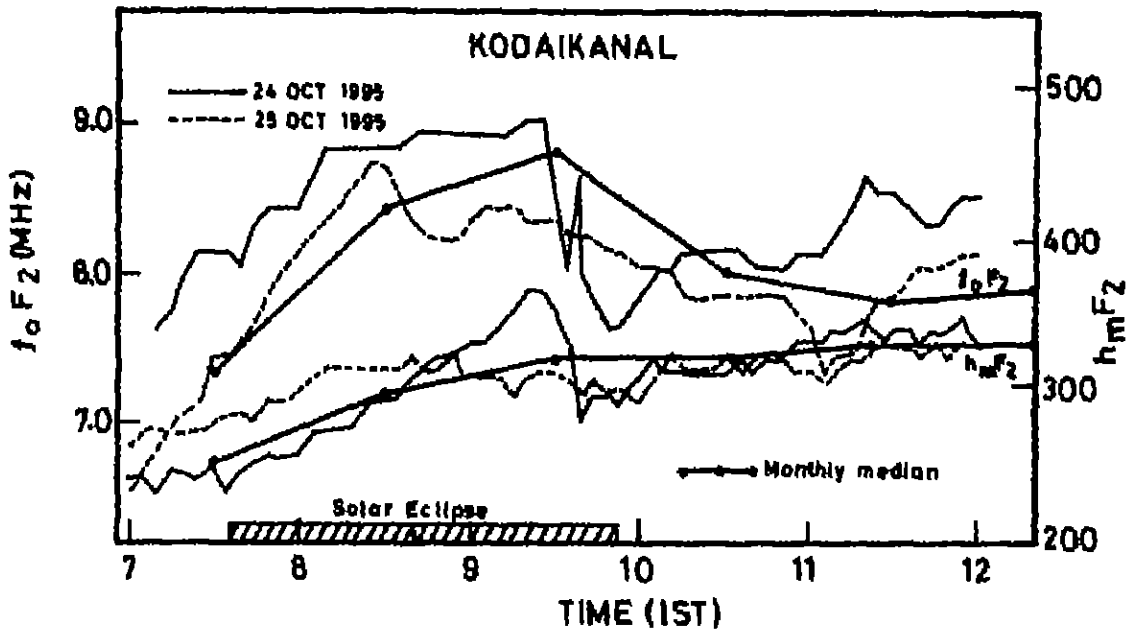

Figure 2 : Variation in Critical frequency (fof2 in MHz) of F2 region and height of maximum Electron density (hmF2 - kms) on 24th and 25th October 1995.

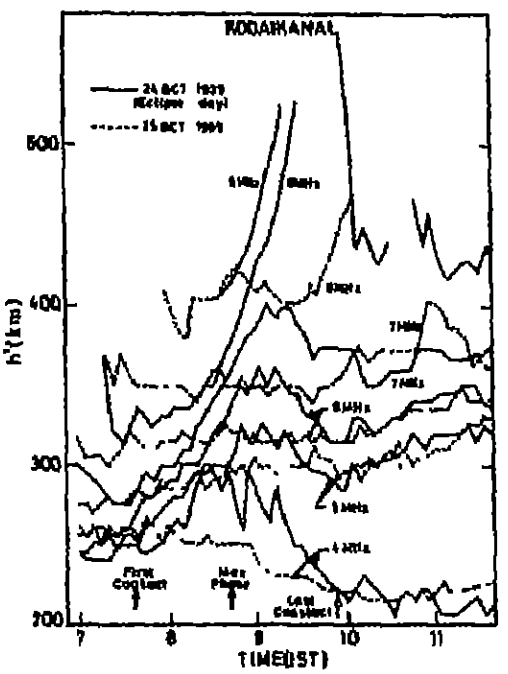

Figure 3 : Changes in virtual height of F-region corresponding to the reflected frequencies of 4, 5, 6, 7, 8 and 9 MHz on 24th and 25th October 1995.

Figure 3 shows that the height was more oscillatory at lower levels by the middle of Eclipse and the fluctuation reduced at higher levels of electron density. There is a marked increase in height at all frequencies and the increase is faster for higher frequencies. The curves are suggestive of the disturbances developed at lower heights being transported upwards as the eclipse proceeds towards its maximum and subside towards end. Normalcy to the control day trend is recovered after the eclipse.

From the above observations we conclude that there was a definite effect of Geophysical importance on the ionosphere over Kodaikanal during the Solar Eclipse on 24 October '95. The change in the rate of electron production with altitude changes electric conductivity and vertical and horizontal transportation of electron density, which play dominant role in modifying the F-region. Clear interpretation to the various cause and effect features observed is not possible unless quantitative N-H profiles and latitudinal structure changes due to eclipse are studied in comparison with ionospheric observation at Waltair and Ahmedabad. Interpretation to changes at F-region peak is difficult. In short, we can say that the equatorial F-region dynamics is a complex one and the solar eclipse makes it more complex.

Acknowledgement

The eclipse campaign at Kodaikanal was held at the instance and under the guidance of Prof. J.H. Sastri.