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I. PHYSICS

Astrophysics (Ionosphere)

IONOSPHERIC ELECTRON CONTENT OBSERVATIONS DURING THE TOTAL SOLAR ECLIPSE OF 16 FEBRUARY 1980

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THE cooling of earth's atmosphere by the passage of the moon's shadow through it during a solar eclipse has been suggested to induce gravity waves. Theoretical predictions about the atmospheric fluctuations caused by the gravity waves have also been made (Chimonas & Hines, 1970 ; and Chimonas, 1970). Attempts have been made to detect such fluctuations and verify the above predictions by different techniques. Observation of the Faraday rotation of a VHF transionospheric signal has become one of the most popular techniques to detect travelling ionospheric disturbances associated with the gravity waves.

Keywords: Ionospheric Electron Content; Gravity Waves; VHF Transionospheric Signal; Faraday Rotation; Electrodynamic Drift of Ionisation.

EXPERIMENT

Description

The Institute of Radiophysics and Electronics of the University of Calcutta operated three AFGL/UCW type polarimeters during the period of February 14 to 18, 1980, to monitor the polarisation rotation of the 136 MHz signal from the geostationary satellite ETS-2 at Berhampore, Durgapur and Diamond Harbour in addition to its permanent station at Haringhata.

RESULTS

Fig. 1 shows the positions of the four stations around Calcutta and the path of totality of the eclipse in the Bay of Bengal. The ray paths of the statellite from the stations pass through the path of totality and the 350km subionospheric points, as indicated by crosses, are within or near the path of totality. The separations between the stations were chosen for obtaining meaningful correlations of the possible periodic structures and their time delays with sufficient accuracy. The look angles for the satellite from the observing locations with the present eclipse path geometry were not expected to show maximum response to the possible TID's; however, the azimuthal angles are still suitable for appreciable response to detect the TID's following the eclipse. As the path of the totality follows more or less a straight line, no focussing effect of gravity waves, as in the case of 1973 African zone eclipse, should occur. Fig. 2 shows the variation of the Faraday rotation angle on February 16, 1980. The plots are displaced vertically for clarity. Analysis shows that no medium scale travelling ionospheric disturbances of appreciable amplitude could be detected from any of the four stations. A slight decrease of 3–4 per cent of the

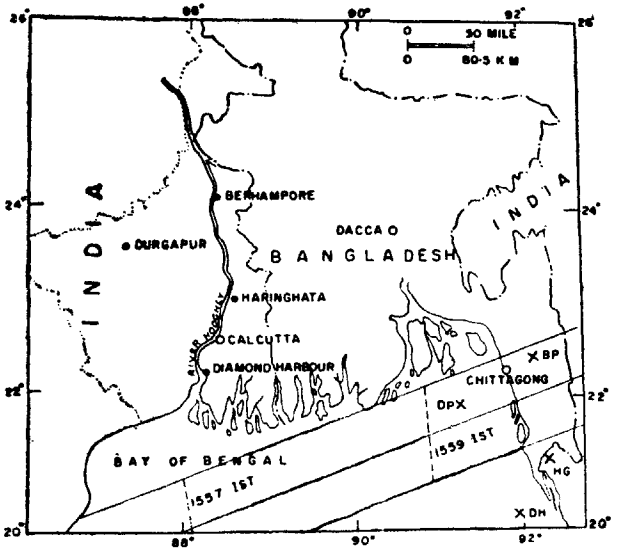

FIG. 1. Geographic locations of the stations in relation to the path of totality of the eclipse in the Bay of Bengal area. Time of eclipse maximum is shown along the path. Filled in circles are the observing stations and the crosses are for the corresponding sub-ionospheric points at 350km. (DH—Diamond Harbour, HG—Haringhata, DP—Durgapur and BP—Berhampore).

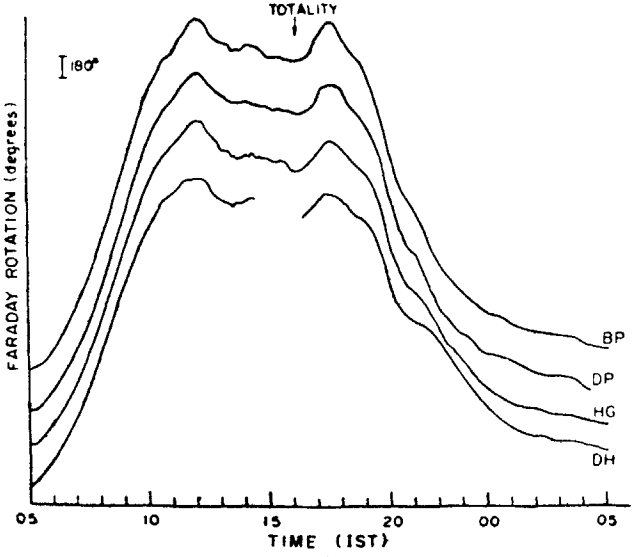

FIG. 2. Variation of the Faraday, rotation angle during February 16, 1980. The plots are displaced vertically for clarity.

ambient value in the ionisation around the time of totality has been observed. The maximum around 1800 hr following the above is a regular feature associated with the movement of the equatorial anomaly crest in this region. It may also be mentioned that a control day (February 15, 1980), prior to the eclipse, prominent TID's have been obtained at locations similar to those reported by Bertin *et al.* (1977), no medium scale periodic structure of significant amplitude could be detected. The null results at the present location are in conformity with those reported by Schodel *et al.* (1973). The above observations suggest that TID's in question may not be of sufficient amplitude to be detected by the Faraday rotation technique.

The 3–4 per cent decrease in the total content around the time of totality may appear to be small when compared to the large decrease in the F-region ionization reported during an earlier partial eclipse (Datta *et al.*, 1959). The earlier eclipse occurred in the morning hours, when production of ionisation was the dominating phenomenon, whereas for the present eclipse occurring in the local afternoon the dominant phenomenon is the electrodynamic drift of ionisation in the equatorial region. Any possible perturbation in the dynamo field due to the eclipse should have its signature on the ionisation near the equatorial anomaly crest about a couple of hours after its occurrence. However, for the present observations, the sunset occurs about two hours after the time of totality and the regular ionospheric processes around the sunset have possibly masked the expected eclipse induced perturbations.

Locations

Berhampore : Lat. 24.08°N, Long. 88.28°E
Durgapur : Lat. 23.53°N, Long. 87.28°E
Haringhata : Lat. 22.98°N, Long. 88.46°E
Diamond Harbour, West Bengal : Lat. 22.19°N, Long. 88.18°E

Participants/Cooperating Groups

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References

Arendt, P. R. (1972) Ionospheric undulations during the solar eclipse of 7 March 1970. *J. atmos. terr. Phys.*, **34**, 719.

Bertin, F., Hughes K. A., and Kersley, L. (1977) Atmospheric waves induced by the solar eclipse of 30 June 1973. *J. atmos. terr. Phys.*, **39**, 457.

Chimonas G., and Hines, C. O. (1970) Atmospheric gravity waves induced by a solar eclipse. *J. Geophys. Res.*, **75**, 875.

Chimonas, G. (1970) Internal gravity wave motions induced in the earth's atmosphere by a solar eclipse. *J. Geophys. Res.*, **75**, 5545.

Datta S., Bandhyopathyay P., and Datta R. N. (1959) Ionospheric observations on the F-region during the solar eclipse of 19 April 1958. *J. atmos. terr. Phys.*, **16**, 182.

Davis, M. J., and da Rosa A. V. (1970) Possible detection of atmospheric gravity waves generated by the solar eclipse. *Nature*, **226**, 1123.

Hunter, A. N., Holman, B. K., Flegate, D. G., and Kelleher R. (1974) Faraday rotation studies in Afriça during the solar eclipse of June 30, 1973. *Nature*, **250**, 205.

Schodel, J. P., Klostermeyer, J., and Rottger J. (1973) Atmospheric gravity wave observations after the solar eclipse of June 30, 1973. *Nature*, **245**, 87.