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I. PHYSICS

Astrophysics (Satellite Scanning)

TOTAL SOLAR ECLIPSE SHADOW IMPRESSIONS AS SENSED BY THE HIGH RESOLUTION SCANNER OF A MOVING SATELLITE

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THE National Remote Sensing Agency (NRSA) Landsat Earth Station receives real-time digital data from TIROS-N series of U.S. polar orbiting meteorological satellites in High Resolution Picture Transmission (HRPT) format and processes Advanced Very High Resolution Radiometer (AVHRR) data to produce radiometrically and geometrically corrected (for earth rotation, panoramic distortions) black and white imageries in all the four bands. AVHRR provides 10-bit data in 0.55–0.90 (B1, B for band), 0.725–1.1 (B2), 3.55–3.93 (B3) and 10.5–11.5 (B4) μm special intervals, with 1.1km satellite subpoint spatial resolution. Details of HRPT format and AVHRR and other sensors characteristics are available in Schwalb (1978).

Keywords : Shadow Impressions; High Resolution Scanner; Real-Time Digital Data; High Resolution Picture; Transmission; Thermal Inertia.

EXPERIMENT

By virtue of the location of NRSA earth station the TIROS-N 10:00:28–10; 15:33 GMT pass of 16 February 1980 was in the microwave visibility of the earth station and this was coinciding with the total solar eclipse event period. NRSA availed of this opportunity and successfully conducted an experiment to capture the solar eclipse impressions in AVHRR enhanced pictures. Incidentally, the earth station was also lying in the total solar eclipse path. The earth station is located at Shadnagar (17.03N, 78.18E), 55km south of Hyderabad.

Since the data in bands 1 and 2 of AVHRR pertain to the amount of solar radiation reflected by the upper boundary of various natural surfaces, clouds etc., the eclipse impressions, and the variations of the reflectivity of earth's surface in and around the shadow regions were observed in the enhanced imageries of these bands. As the phenomenon of totality of eclipse was only of a few minutes duration, and because of the high thermal inertia of earth, these variations were not so much observable in the pictures for bands 3 and 4. As expected, a general reduction in the emission intensity in thermal IR bands was noticed.

The picture at Fig. 1 refers to band 1 data and was obtained by suitably adjusting the gain and bias controls with enhancement using a mapping algorithm corresponding to a sawtooth wave type. This picture is a result of complex interrelationship of satellite dynamics, satellite scanning geometry, eclipse kinematics and eclipse geometry. Further, the different areas of the image have been scanned at different times. The picture refers to data obtained during 10:05:10–10:12:21 GMT. During this period, the total solar eclipse phenomenon was taking place over the

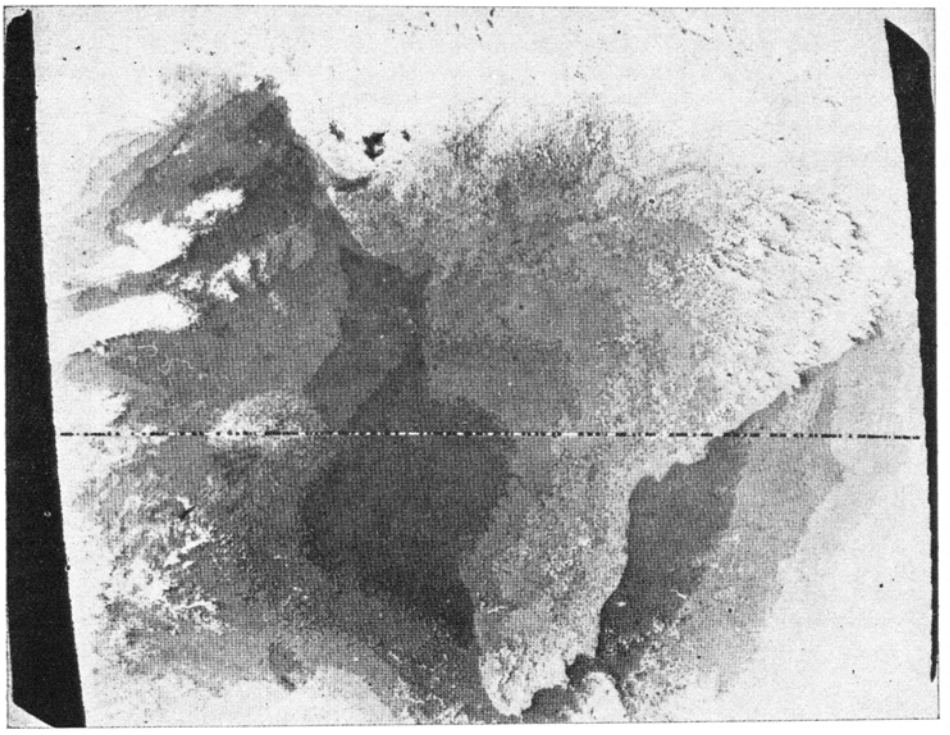

FIG. 1. Picture in visible band TIROS-N AVHRR data for 10 : 05 : 10–10 : 12 : 21GMT

Arabian Sea. The authors have computed the coordinates and time of scanning for about 57 shadow boundary discriminating points and have given explanation to the variance of shadow intensity observed within a shadow zone and to the observed variation of shadow intensity in different shadow zones using the eclipse data of Fiala and Marie (1978), soil and vegetation type information over land. The shadow is more pronounced over sea surface because of its poor scattering property as compared to land.

The HRPT format also contains the data of Space Environment Monitor (SEM) sensing system which consists of data from Total Energy Detector (0.3 KeV to 20 KeV), Medium Energy Protein and Electron Detector (30 KeV to 60 KeV) and High Energy Proton-Alpha Detector (370 MeV to 850 MeV). Here, the figures within brackets refer to energy range. The SEM data is also available with NRSA in HRPT format.

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