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Dependence of Ionospheric Absorption at Udaipur on 10.7-cm Solar Flux

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The dependence of ionospheric absorption on solar activity during the period 1974-80 at frequencies 2.3 and 2.5 MHz over Udaipur (24°35'N) has been studied. It has been found that the variation of noontime ionospheric absorption (A) with 10.7-cm solar flux may be represented in an exponential form rather than the linear one. The advantage of this representation is that the observed saturation value of absorption is also accounted for.

The influence of solar activity on ionospheric absorption has been studied earlier by many workers[1-5]. It has been found that the ionospheric absorption bears a linear relation of the type

$$A = A_0 (1 + b R_z) \qquad \ldots (1)$$

with sunspot number (R_z). Gnanalingam[6] has used 10.7-cm solar flux ($F_{10.7}$) as the index of solar activity and shown that the variation of absorption with $F_{10.7}$ can be represented as

$$A_{2.2} = 30.6 + 0.21 (F_{10.7} - 70) \qquad \ldots (2)$$

where $A_{2.2}$ is the smoothed noon absorption in dB normalized for 2.2 MHz. Victor *et al.*[7] have analyzed the absorption data obtained at Colombo. They found that the variation of absorption with sunspot number follows a second degree polynomial rather than a linear one.

In the present investigation 10.7-cm solar flux has been used as the index of the solar activity which is a better index than sunspot number, since it is closely associated with the flux of solar extreme ultraviolet radiations[8] and are presumed to produce ionization in the lower region. It has been found that the value of observed ionospheric absorption does not change significantly after the 10.7-cm solar flux has reached a particular value. The variation of monthly mean value of absorption normalized for $\cos\chi$ with 10.7-cm solar flux ($F_{10.7} < 180$ units) at 2.5 MHz under quiet conditions may be represented as follows.

$$A_{2.5} = A_0 [1 + 0.0094 (F_{10.7} - 65)] \qquad \ldots (3)$$

For higher values of 10.7-cm solar flux, Eq. (3) does not represent the observed values of absorption. In the present study an attempt has been made to represent the dependence of absorption on solar flux by a new type of relation which agrees with the experimental results.

Frequencies 2.3 and 2.5 MHz have been used in the present study, since these frequencies were always away from the critical frequency of the E-region. This excludes the possibility of excessive deviative absorption at any time. The absorption data obtained at both the frequencies have been normalized for $\chi = 0$. The monthly mean normalized absorption at 2.3 and 2.5 MHz has been plotted against 10.7-cm solar flux (Fig. 1). Fig. 1 shows that the ionospheric absorption increases with the increase of $F_{10.7}$ till the flux reaches about 180 units after which the absorption seems to be saturated. The dependence of ionospheric absorption on 10.7-cm solar flux may be represented by the following empirical relation

$$A = A_m [1 - \exp(-b F_{10.7})] \qquad \ldots (4)$$

where A is the normalized absorption, A_m is the saturation value of normalized absorption and b is a

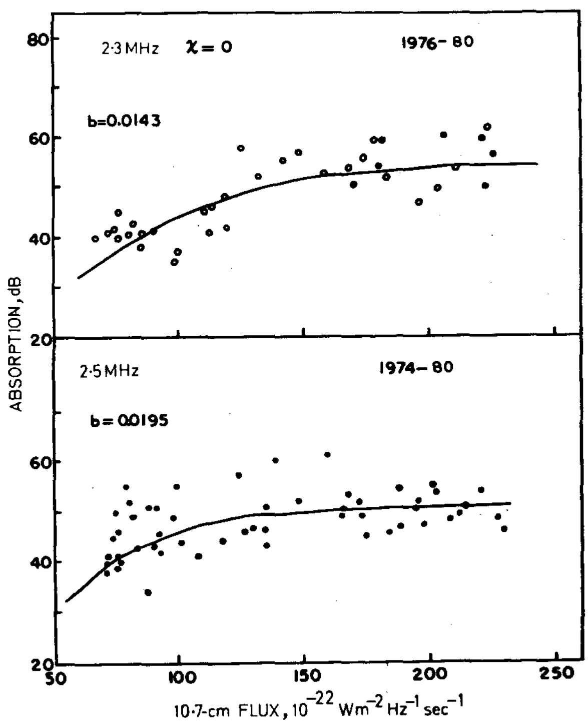

Fig. 1—Curves showing the solar cycle variation of absorption

constant. The method of inspection has been carried out and exponential curves by adjusting the value of b have been drawn to satisfy the observed results.

The saturation in absorption after the 10.7-cm solar flux reaches 180 units may be due to saturation of flux of ionizing radiations which are responsible for maintaining the lower ionosphere. Chakrabarty and Chakrabarty[9] have shown that the X-ray flux in 0-8 Å and 1-20 Å bands tends to be saturated after a particular value of 10.7-cm solar flux. Bibl *et al.*[10] and Gnanalingam and Ratnasiri[2] have also reported similar saturation effect of absorption for values of R_z greater than 180.

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References

1 Appleton E V & Piggott W R, *J Atmos & Terr Phys (GB)*, **5** (1955) 141.
2 Gnanalingam S & Ratnasiri P A J, *Ann de Geo*, **22** (1966) 361.
3 Schwentek H, *J Atmos & Terr Phys (GB)*, **33** (1971) 1839.
4 Mbipom E W, *J Atmos & Terr Phys (GB)*, **33** (1971) 1263.
5 Samuel J C & Bradley P A, *J Atmos & Terr Phys (GB)*, **37** (1975) 131.
6 Gnanalingam S, *J Atmos & Terr Phys (GB)*, **36** (1974) 1335.
7 Victor P, Rao D N M & Ramana K V V, *Indian J Radio & Space Phys*, **9** (1980) 8.
8 Hinteregger H E, *Ann Geophys (France)*, **26** (1970) 547.
9 Chakrabarty D K & Chakrabarty P, *Indian J Radio & Space Phys*, **2** (1973) 211.
10 Bibl K, Paul A & Rawer K, *J Atmos & Terr Phys (GB)*, **27** (1965) 145.