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Ionospheric Perturbation Caused by Solar flares as determined from VLF subionospheric propagation Studies at Agra, India

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Studies of very low frequency (VLF) subionospheric propagation of fixed frequency VLF transmitter signals [NWC, (19.8 kHz), NPM (21.4 kHz) and NAA (24 kHz)] have been in progress at Agra (geograph. lat. 27.2oN, longi. 78oE) India since the year, 2002. Earlier we used absolute phase and amplitude data logger (Abs PAL) purchased from LF EM Low Frequency Electromagnetic Research Ltd, Australia which was later replaced by Soft PAL system. The observations have been taken at Bichpuri Campus, located in rural area about 12 Km west of Agra city where local disturbances due to electrical malfunctioning are low.While earlier studies were intended to monitor the effects of lightening and earthquakes, recently we have oriented our studies to examine the effects of solar flares on a moderate path (GCP 6600 Km, Agra-NWC, Australia). We have analysed the data for a period of one year between 01 January, 2011 and 31 December, 2011 and found 47 cases of solar flare induced perturbations which are correlated linearly with X-ray fluxes of varying intensities. The amplitude perturbations appear as enhancements (dA) which lie in the range of 0.6 dB to 5.36 dB. Assuming unperturbed ionospheric height of reflection H'= 71 Km and sharpness factor Beta = 0.43 Km-1, we have calculated the flare induced ionospheric height H' = 66 Km and Beta = 0.48 Km-1. The electron density at this height of reflection is found to be 801.61 cm-3. This is consistent with IRI-2007 model electron density with an error ˜10 percent.