

# Studies on solar flare effects on propagation of sferics and transmitted signal

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Solar flares cause significant perturbations in the received VLF signals propagating in the Earth-ionosphere wave-guide. Flares release energy in the form of electromagnetic radiation (from radio waves at the long wavelength end, through optical emission of X-rays and gamma rays at the short wavelength end), energetic particles (electrons and protons) and mass. All flares are high emissions in the wavelength range 1–8 Å. These wave-lengths ionize the D-region, which results in radio absorption.

The intense radiations from solar flares when travel towards the earth, there will be enhancement of D-region ionization. For this, the characteristic features of Integrated Field Intensity of Sferics (IFIS) are greatly affected. The Fourier spectrum of IFIS extends from extra low frequency to high frequency. The contribution is mostly from VLF band.

Stratospheric electric fields get modified due to conductivity enhancements caused by the energetic particles during solar flares. Works were reported earlier about the statistical relationship between the occurrences of solar flares and the variations of lower atmospheric electricity parameters.

There is always a correlation among atmospheric electricity, aurora, sunspots, geomagnetic activity, and solar X-ray flares. Very often, the observed responses on Sferics are confusing and are difficult to understand in terms of solar terrestrial interactions.

The present work deals with the observations of solar flare effects on the Integrated Field Intensity of Sferics (IFIS) recorded at Agartala (Lat. 23° N) at frequencies 1, 3, 6, 9 and 12 kHz. Observations exhibited substantial enhancement in the IFIS during the occurrences of solar flares in July, 2004. The effects of solar flares on sub-ionospheric signals at 16.3 kHz recorded on November 23, 2004 from Kolkata (Lat. 22°34' N) are also presented. The occurrences of flares are justified by GOES satellite data both in long and short X-ray range.

The comparative study of our recorded Sferics spectra during solar flares with those of GOES satellite data suggests some sluggishness, which is the time lag observed in between the occurrence of solar flares and sudden enhancement of atmospherics (SEA). This observed sluggishness is due to relaxation effect in the ionospheric region.

During solar flares, the intensity of solar X-ray fluxes heading towards the earth's atmosphere increases the ionization and hence the reflection coefficient as well as reflection height are altered for a short period. This is observed as a sudden change in the amplitude of ARNFS in the ELF-VLF range.

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