Ionospheric influences of the solar flares

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The studies conducted in the past concerning ionospheric influences of solar flares have used the Global Positioning Satellite System (GPS) derived Total Electron Content (TEC). In our present study we validate these studies by using ionospheric parameters derived from ground based Ionosonde measurements. We investigated the effect of enhanced X-ray and EUV fluxes on the upper and lower ionosphere during thirty X-class solar flares that occurred during 2000-2011. The thirty flares have been selected based on their visibility at the chosen Ionosonde station and the availability of various data sets. The data of X-ray flux (0.1 – 0.8 nm) from Geostationary Operational Environmental Satellite (GOES) and EUV flux (26 – 34 nm) from Solar EUV Monitor (SEM) onboard Solar and Heliospheric Observatory (SOHO) are correlated with the ionospheric parameters fmin (frequency of minimum reflection of D layer) and NmF2 (maximum electron density of F2 layer) to establish the extent of impact and magnitude of correlation in the two layers. The data with lowest possible resolution has been utilized to capture the flare effects. The Ionosonde data of Okinawa (lat.26.30N, long.158.70E) station, Japan are utilized for the present study. The peak values of both fluxes and ionosphere parameters are considered to study peak to peak correlation while as enhancements of radiation fluxes have been estimated from the background, the enhancements of ionospheric parameters are estimated from the daily mean for each flare.

The correlation analysis was performed to bring the correspondence between ionospheric parameters and radiation fluxes. From our analysis we found that the peak values and peak enhancements of ionospheric parameters follow a good correlation with peak values and peak enhancements in radiation fluxes. During the analysis we noted that the flares of same magnitude or same intensity e.g say X1.0 do not produce the same effect on the ionosphere. While some flares cause intense ionization the others produce a very slight effect. This may be due to two reasons: a large difference in the spectral properties of flares and the occurrence of flares at different heliographic latitudes. The location of flares on the solar disc can be taken care of by adjusting the fluxes to CMD (Central Meridian Distance). When we multiplied the fluxes by Cos(CMD) the correlation between the flux and ionospheric parameters is vastly improved. The flares occurring at central portion of the solar disc are more effective than those flares occurring near limb. At the same time it was also found on account of their much higher energy and penetration power, X-ray photons produce intense ionization in the lower ionosphere (D-layer) than the EUV flux.