Solar Transients Disturbing the Mid Latitude Ionosphere during the High Solar Activity

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Abstract. We investigate the effect of solar transients on the mid latitude ionosphere during the high solar activity period of solar cycle 23 i.e 2003 and 2004. A mid latitude station, Guangzhou (23.1N, 113.4E) was selected to carry out the investigation. The ionospheric behaviour at the selected station is characterized by considering the critical frequency of F2 layer (foF2) obtained by using the ground based Ionosonde observations. Then we selected two types of solar transients viz. solar flares and Coronal Mass Ejections (CMEs). To quantify the effect of solar flares we have considered the X-ray flux (1–8Å) and EUV flux (26–34nm). Similarly to quantify the effect of CMEs, we have considered the geomagnetic storms, because during high solar activity the geomagnetic storms are caused by CMEs. From our analysis we conclude that during the geomagnetic storms the value of foF2 decreases as compared to quiet days thereby showing a negative effect. On the contrary we found that during solar flares there is sudden and intense increase in foF2. We also performed a correlation analysis to access the magnitude of association between changes in flux values and peak values of Dst during flares and storms with the corresponding changes and peak values of foF2. We found that a strong correlation exists between the enhancements/decrements in foF2 and enhancements in flux values and Dst .We conclude, while geomagnetic activity suppresses ionospheric activity the flares enhance the same.

1. Introduction

Ionosphere, the upper part of earth's atmosphere, is highly vulnerable to solar disturbances. During solar disturbance like solar flares and Coronal Mass Ejections huge amount of energy is released from the sun in very short duration of time. This energy eventually reaches the geospace and is transferred to the magnetosphere where it causes several changes in the magnetosphere. Since the magnetosphere and ionosphere of earth form a coupled system therefore the state of ionosphere also gets disturbed largely due to such disturbances. The solar flares and CMEs affect the ionosphere differently.

During solar flares the release of energy occurs in the form of radiations. The increase in the radiation flux at specific wavelengths like X-ray and EUV is considerably large. Consequently, as the amount of X-ray and EUV flux impinging on the ionosphere increases, the ionization process in the ionosphere shoots up leading to sudden and intense increase in the electron density of ionosphere.