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Effect of solar X-rays on ionosphere

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Extended Abstract

One of the most dramatic effects on the ionosphere of the Earth is created by the impact of solar X-ray bursts. The energy of the X-rays causes a rapid enhancement of the electron density in the ionosphere. If the intensity of the X-rays is sufficient in producing a high enough enhancement of the electron density in the D region of the ionosphere, radio waves traversing the ionosphere will be absorbed.

The ionospheric absorption of radio waves can be measured directly with the Canada Riometer Array [1]. A Riometer [2] measures the radio wave emissions from distance galactic radio sources at a prescribed radio frequency. The variation in the signal level for antenna with vertically directed beam pattern depends only on the sidereal time in the absence of absorption. During an absorption event, a depressed signal level is detected. The amount of signal depression is directly related to the radio wave absorption.

By comparing the level of radio wave absorption from the Riometer with the intensity of the X-ray burst measured by the GOES satellite, the radio wave absorption is found to be proportional to the square root of the flux intensity of the X-ray burst. A cosine-squared dependence with zenith angle was noted indicating that a more directly overhead burst causes more absorption. In addition, a delay is found to be 18-20 seconds between the time of X-ray emission as detected by GOES and the time of absorption in the ionosphere. A detailed analysis of X-ray flares between 2011 and 2014 shows that some flares are more effective at producing absorption than others. In an attempt to understand the difference some keys parameters of the X-ray burst are considered. Solar longitude of X-ray burst for several X-class flares shows no consistent pattern of enhancement in the absorption. Results from this study will be very useful in updating current models of radio wave absorption in the ionosphere.

References

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