International Journal of Scientific and Technical Advancements

ISSN: 2454-1532

Impact of Solar Ultravoilet Radiation on Ionosphere

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***Abstract*—** Solar ultraviolet radiations affect the total electron content of the ionosphere that may disturb the radio-frequencies used in telecommunications. It may state with full confidence that the increase in the critical frequencies of the F2 layer from the values observed in the morning hours to the afternoon maximum frequencies, is due to ultraviolet (SUV) radiation from the Sun. During an ionospheric storm, some radio frequencies are absorbed and others are reflected, leading to rapidly fluctuating signals and unexpected propagation paths. In the present work, we have shown that the effect of various solar activities that effects the electron densities of the ionosphere and how they affect our telecommunication system. During solar maximum years, maximum variations of electron density of the ionosphere have been observed. Hours of maximum disturbance due to increased electron density of the ionosphere were obtaining measuring electron density of the ionosphere. Solar flux is the basic indicator of solar activity that determines the level of radiation being received from the Sun. The solar flare closely related to the amount of ionization and hence the electron concentration in F2 layer region as result it gives a very good indication of condition for long distance communication the solar flux can vary from low as 50 to high as 300; low value indicate the maximum useable frequency will low and over all condition will be very good for higher HF band. Conversely high value generally indicate there sufficient ionization to support long-distance communication at higher than normal frequencies. However it takes a few days of high values for conditions to improve. These results will provide information for space weather forecasting and also enable telecommunication industries make predictions and necessary adjustments to maximize their operational frequencies.

***Keywords*—** Radio frequencies; ionosphere; SUV; electron density; interplanetary magnetic field (IMF).

I. Introduction

The effect of solar energetic particles (SEPs) and radiations in the interplanetary space and on the Earth, termed as space weather, is an active area of research in global communication and space exploration. The Sun influences our entire lives and also our environment. Since ancient times, human kind has been conscious that the life on Earth is sustained by Sun. The Sun influence on the Earth can observe by the interplanetary magnetic field (IMF) and the solar wind. The magnetic field on the Sun is the root cause of the emission structures and their variation. The plasma from the Sun's corona, called the solar wind rushes out in to interplanetary space, which contains an imprint of the Sun's magnetic field. Mainly, interplanetary magnetic field responsible for changes of environment of Earth. Interplanetary magnetic field has spiral from and field can mention Sun inclination 7.5 degree seen from Earth and interplanetary field line. The Sun at center rotate counter clock wise and drag magnetic field from photosphere into interplanetary space northern. Solar polar region in this example might have a opposite or outwardly directed magnetic polarity the southern hemisphere has opposite a negative or inwardly directed the rotation of the Sun with inclination accompanying current sheet therefore make it possible for Earth depending if it's orbit is above as below the Sun equator plane to pass through the heliosphere current sheet and in top M region positive or negative IMF polarity, the interaction of both ± interplanetary magnetic field, have to interplanetary and Earth's plus dynamo effect sudden violent coronal mass ejection accompanied by high velocity solar wind that create shockwave hitting Earth's magnetic field cause the ejected charged solar particles to spiral downward around Earth magnetic field like enter the polar zone there they create the fascinating polar light in the ionosphere above E zone. The Sun makes our Earth warm and provides comfortable place to live in. It provides us the heat and creates daylight by emitting electromagnetic radiation from the Sun. The effect of the solar radiation and particles that stream out from Sun would be quite deadly for inhabitants of Earth. Earth's atmosphere is block out by the X-rays and ultraviolet radiation. When X-ray or ultraviolet photons encounter the atmosphere they hit molecules and absorbed, causing the molecules to become ionized; photons are reemitted but at much longer (and less biologically destructive) wavelengths. The second protective mechanisms is the Earth's magnetic field is protects living organisms from the charged particles that reach the planet steadily as part of the solar wind and the much greater that reach planet steadily as part of the solar wind and the much greater bursts that arrive following mass ejections from the Sun. Solar and Interplanetary origin of space disturbances, as well as related magnetospheric dynamics. The properties of the Earth's coupled magnetosphere-ionosphere system are dominated by its interaction with solar wind plasma. Mediated by magnetic reconnection at magnetopause interface as consequences; Earth's magnetosphere dynamics depend on concurrent IMF. The properties of Earth's coupled magnetosphere-ionosphere system are dominated by its interaction with solar wind plasma. Mediated by magnetize reconnection at the magnetopause interface. As a consequence; primarily on the concurrent orientation of the IMF. The Earth's magnetosphere is major practical relevance; as it is the plasma medium in which range of applications space craft, used for communication navigation; metrology and defense. Primary source of space weather is Sun. Variation in the electromagnetic and particulate output of the

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Sun is the main cause of change in the Earth's upper atmosphere and surrounding region known as Earth's magnetosphere. These effect in communication; navigation and many other space ground based system. Most of the variation occurs in the lower and upper parts of solar spectrum; the radio and X-rays bands. At these wave lengths the solar radiation can vary by many orders of magnitude. X-radiation in particular, penetrates below about 60 km.

II. Ionospheric Disturbances

The ionosphere can be visualized as containing a number of layers. In fact, there ionization throughout the ionosphere; the layers are really peaks in the levels of ionization. The ionosphere affects radio waves because according to the level of ionization, the signals are refracted, i.e., bent away from traveling in a straight line. Often the level of ionization is sufficiently high to enable the signals to be returned to Earth. Conditions are continually varying levels of ionization in the ionosphere. The radiation coming chiefly from the Sun hits upper ionosphere, causing positive ions and free electrons. A state of "equilibrium" exists. The free electrons that affect radio waves recombine with positive ions and free electrons that affect radio wave recombine with positive ions to reform molecules. When levels of ionization are higher ionosphere are more capable of bending back radio signals to Earth. Also, high levels of ionization mean high maximum usable frequencies and better HF conditions.

The level of ionization at any given point above the Earth is dependent upon a number of factors including the time of day. The season and most important of all the sunspot cycle, it found that level of radiation activity from sun increases as the number of sunspot increases. Accordingly, the level of radiation received from the Sun peaks around the top of the sunspot cycle. In fact, it is the bright area around the sunspot called plage that emits most of the extra radiation. At the sunspot also rises, this happens as the Sun emits vast quantities of particles. There is normally a steady flow of these at time solar flares emission greatly increases, when hits the Earth's magnetic field it becomes disturbed, creating a geomagnetic storm that detected at point around the globe. Another effects is that the ionosphere itself can disturbed, giving rise to an ionosphere storm. This will degrade HF communications and when particularly bad it can lead to total HF blackout.

The ionosphere is region of the upper atmosphere, extends from about 8.5 km to 600 km altitude, and includes the thermosphere and parts of the mesosphere and exosphere. It is distinguished because it is ionized by solar radiation. It plays an important role in atmospheric electricity and form the inner edge of the magnetosphere. Ionosphere has practical importance because, among other functions, it influences radio propagation to distant places of Earth; ionization depends primarily on the Sun and its activity. The amount of ionization in the ionosphere varies greatly with amount of radiation received from the Sun. thus there is diurnal effect and seasonal effect. The local winter hemisphere is tipped away from the Sun, thus there is less received solar radiation. The activity of the Sun is associated with sunspot cycle, with more radiation occurring with more sunspots. Radiation received also varies with geographical location (i.e. polar, auroral zones, mid-latitudes and equatorial regions). There are also mechanisms that disturb the ionosphere and decrease the ionization. There are disturbance such as solar flares and the associated release of charged particles in to solar wind which reaches the Earth and interact with its geomagnetic field, the ionosphere is part of Earth's upper atmosphere where free electron occur in sufficient density to have an influence on the propagation of radio frequency electromagnetic waves. Most of its ionization is produced by X-ray and ultraviolet radiation from the Sun. As Earth rotates ionization in the sunlit atmosphere and decreases on the shadowed side. Ionization appears at atmosphere levels, producing layers or regions which may be identified by their interaction with radio waves.

III. Ionospheric Storms

For Ionospheric storms are disturbance in Earth's magnetic field. They are associated with solar eruption and the 27 Day intervals, thus corresponding rotation of the Sun, 18 hours' time difference between a sudden ionospheric disturbances (SID) and ionospheric storm. Ionospheric storm associated with sunspot activity may begin any time from 2 days before an active sunspot crosses the central meridians of Sun until four hour days after it passes the central meridian. However, active sunspots have crossed the central region of the Sun without any ionospheric storms have occur when there were no visible spots on the Sun and no preceding SID. Some correlation between ionospheric storms, SID, and sunspot activity is possible, ionospheric storm the most prominent effect of are turbulent ionosphere and very erratic sky wave propagation. Critical frequencies are lower than normal, particularly for F_2 layer. The correlation between the variation of ionization in F_2 layer and variation in solar activity shows the ionosphere containing number of layers. In fact there is ionization throughout the ionosphere; the layer are really peak's in the level of ionization, the ionospheric affect radio waves because the level of signal refracted, i.e., bent away from traveling in straight line. Often the level of ionization is sufficiently high to enable the signal to returned Earth. The solar radiation coming from the Sun hit's Earth upper atmosphere causing molecules to ionize, creating positive ions and free electrons, a state of dynamics equilibrium exists.

SEPs also influence terrestrial radio wave propagation through polar region in the separate processes which affects only the sunlit side of the Earth. SEPs are shielded from lower latitudes by the Earth's magnetic field. Polar cap absorption (PCA) events are troublesome to radio-navigation techniques making use of nearly constant height of reflection of very low frequency waves find the propagation time, hence the distance to the bacon, during the PCA events the height of radio wave reflection is lower (Davies 1990). SEPs can penetrate the polar region, which increase ionization rate there, resulting in enhanced absorption of radio-wave in the D region (Shea et al 1990). High energetic ions penetrate electronic components, causing bit flips in a chain of electronic signals that can result

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in improper commands with in space craft or incorrect data from instrument less energetic particles contribute to a variety of space craft. Solar radiation and other solar activity affect the total electron content of the ionosphere and also affect various radio frequencies used telecommunication.

IV. Galactic Cosmic Rays and Ionosphere

Ionosphere and atmosphere play important role of space weather mechanisms. The galactic cosmic rays (GCRs) influence the ionization and therefore the electrical parameters in the planetary atmosphere (Singh et al., 2011). The GCRs transfer the impact of solar activity in to atmosphere (Singh et al., 2010). In such a way cosmic ray influence the ionization, chemical and electrical state in the region 5-100 km. Near ground (0-5 km), there is an additional ionization source via natural radioactivity of the soil that may important in some regions related to radon gas emission (Usoskin et al., 2011). The application of monte-carlo methods for investigation of cosmic ray ionization is important, because it is possible to consider explicitly the hadron component and therefore to estimate effects in the lower (0-10 km) and middle (10-100 km) atmosphere, as was recently demonstrated their application in specific, realistic conditions (Mishev and Velinov, 2010) permits to study of the ionization effect, especially at different altitudes. Intense cosmic ray fluxes during forbush decreases can be responsible for a number of radiation effects in electronics and sensor systems of space crafts and aircrafts. The natural space radiation environment can be classified in two populations; the particles trapped by planetary magnetosphere in belts', including protons, electrons and heavier ions and transient particles which include protons and heavier ions. The transients radiation consist of GCRs and particles from solar events, such as solar flares (SFs) and CMEs.The impact of GCR on micro-electronics systems of spacecrafts and aircrafts. The Earth atmosphere operates as natural shield, preventing most cosmic ray's from reaching its surface, specifically, when primary Cosmic ray reach the atmosphere, they interact with its constituents, Nitrogen and Oxygen, generating a cascade of secondary particles. On satellite orbiting outside the magnetosphere, similar interactions of cosmic rays with spacecraft materials complicated shielding evaluations, due to generation of multiple daughter products. Similarly, incident electrons produce penetrating X-rays, or bremsstrahlung, as they scatter and slow down, interacting with spacecraft materials.

The level GCR are modulated by the 11-year solar cycle with peak of GCR population occurring near solar minimum. Superimposed on GCR levels are unexpected sudden rises in the flux levels due to SEPs. Galactic and solar particles have unimpeded access to space craft outside the magnetosphere. Those particles that penetrate into Earth's magnetosphere reach near-Earth orbiting space craft and are particularly hazardous to satellite in polar, highly elliptical and geostationary GEO orbits (Berth et al., 2003). GCRs hazards to space weather systems followings (a) galactic cosmic ray radiation damage to space craft electronics, solar cells; and materials, from the Earth's trapped radiation belt particles and from solar and galactic energetic particles.; (b) single events effects (SEEs) in spacecraft electronics, due to ionization from GCRs to ionization from secondary's produced nuclear interactions between the incident heavy ions and component materials.; (c) interference to spacecraft imaging and sensing systems; (d) electrostatic charging from plasma and energetic electrons.

V. Conclusion

Solar transients; solar flares, coronal mass ejections (CMEs), solar energetic particles (SEPs) are drivers of the space weather effect in geospace. Solar transients: solar flares, CMEs and solar energetic particles are the consequence of one energy release process in which the coronal magnetic energy release in term of flashes and mass motions; solar proton events are mostly associated with solar flares and thought to be accelerated at the reconnection site in flaring plasma The CMEs initial velocity seems to have some direct or indirect connection with the nature of flaring plasma as all these solar transients: flares, CMEs, particles found be produced from the magnetically complex regions in the solar corona. Sun itself is natural laboratory which provides us opportunity to study the acceleration processes of charged particles up to MeV - GeV energies. Solar energetic particles can escape in to interplanetary space through open field line and can be observed with in situ particles detectors allowing sampling of particles accelerated at Sun. The energy release through X-rays in solar flares is mostly X-rays in solar flares is mostly due to bremsstrahlung emission. Good correlation has been found between spectral hardness of nonthermal HXR emission and X-ray flux at the corresponding energy (Grigis and & Benz 2004; Flecther &Hudson 2002). Solar radiation is the most intense source of energy supplied to the terrestrial atmosphere, and there is wealth of evidence in favor of the response of atmospheric parameters to solar variations our need to asses environmental impact on human kind's technological systems requires a better understanding of electrical processes in Earth's atmosphere. Further research needed to understand better the natural electrical environment and its variability and it predicts its future evolution. The effect of solar radiation, space radiation on spacecraft materials and devices are one of the main reasons of arising of the spacecraft operation failure and life time reduction.

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