

# Impact of Variations of Electron Density in Atmosphere on human life

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**ABSTRACT:** The present paper describes results of the studies devoted to the solar activity impact on the Earth's upper atmosphere and ionosphere, conducted at number of stations all over the globe with ionosonde and total electron content. Although both electron densities calculated with ionosonde and total electron content represent the same variation, the different ways of calculation gives different kinds of errors and different impacts on the atmosphere. All the errors cumulatively disturb the atmosphere in different ways and induce the disruption to the communication in the atmosphere.

**KEYWORDS:** Ionosphere, Ionosonde, Electron Density, Equi Potential

## I.INTRODUCTION

Both the sun and the Galaxy contribute fluxes of ionizing particles. The quiescent Sun constantly emits a solar wind of about 5 to 10 protons, electrons, and particles per cubic centimeter traveling at speeds of about 500 km/s. These particles do not possess penetrating energies and therefore offer no threat to humans. However, the solar wind may indirectly affect humans because it neutralizes any separation of electric charge that might occur in space and produces a small variable interplanetary magnetic field (~5 nT at the distance of the Earth (1 AU) from the Sun). Consequently, space contains essentially no electric field, whereas on Earth the electric field is 100 V/m near the surface.

Given that the human body is a good electrical conductor and forms an equipotential surface in the Earth's field, and that humans live a good portion of their lives in electrostatically shielded buildings, it seems unlikely that living for prolonged times in the absence of an electric field would cause harm, but this is not definitely known. Similarly, although there is evidence that living in magnetic fields thousands of times more intense than the Earth's will harm people, the consequences of living in a magnetic field that is both 10,000 times weaker and variable with time are not known. Solar flares and galactic cosmic rays on the other hand are direct and serious threats to life in space. In sporadic violent eruptions the Sun emits blasts of high energy protons capable of delivering dangerous doses of radiation.

This solar flare illustrates the worst known radiation conditions to be expected in space. Without a space habitat having extensive protection against extremely energetic protons such a flare would contribute many tens of rem of dose in less than an hour to moderately shielded personnel, and many times the fatal dose to the unprotected human being. The frequency of dangerous cosmic-ray flares is once in several years during a solar maximum, and once in a few decades for a flare as large as the class 4 flare. Because a significant portion of the protons originating from a large flare are relativistic, there is only a few minutes between optical and radio indications of an outburst and the arrival of the peak of the proton flux. People not in a sheltered place have very little time to get to one. Once a flare has begun, fluxes of energetic particles persist for a day or so in all directions.

Cosmic rays from the galaxy are a continuous source of highly penetrating ionizing radiation. The lower-energy portions of the curves show the modulating effect of the solar wind which with varying effectiveness over the 11-year solar cycle sweeps away from the Sun the less penetrating particles of the galactic cosmic rays. In the absence of any

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shielding the galactic cosmic radiation would deliver an annual dose of about 10 rem. An important feature of note in figure 2-7 is the presence of heavy nuclei such as iron. In fact, heavy cosmic ray nuclei range up to heavy transuranium elements but quite noticeably peaking in abundance around iron. When a fully ionized iron nucleus is traveling below about half the speed of light its ionizing power is several thousand times that of minimally ionizing protons. At this level of ionizing power the passage of a single iron nucleus through the human body destroys an entire column of cells along its trajectory. The total amount of energy dumped in the body is small, but it is concentrated intensively over localized regions

## II. DATA OF RELATED WORK AND METHOD OF ANALYSIS

In order to observe the interplanetary variations of the storm as per shown in Fig.1, the data of solar wind velocity, Ion temperature and IMF Bz data were collected from the website [http://ftpbrowser.gsfc.nasa.gov/ace\\_merge.html](http://ftpbrowser.gsfc.nasa.gov/ace_merge.html) and the Dst and AE data was collected from the world data centre Kyoto <http://wdc.kugi.kyoto-u.ac.jp/dstae/index.html>. The magnetic Ap index and F10.7 solar flux data was taken from the <http://omniweb.gsfc.nasa.gov/form/dx1.html>.

In order to study the details of this strong storm and its ionosphere response over the globe, the Ionosonde data from Digital Ionosonde Data base, and ionosonde from Australian government world data centre were considered and the data was downloaded from <http://ulcar.uml.edu/DIDBase/> and [http://www.ips.gov.au/World\\_Data\\_Centre/1/3](http://www.ips.gov.au/World_Data_Centre/1/3) respectively. Waltair data is collected from Waltair station. Simultaneous measurements of TEC for the considered storm period were taken from Arecibo and the data was taken from <http://www.naic.edu/aisr/GPSTEC/gpstec.html>

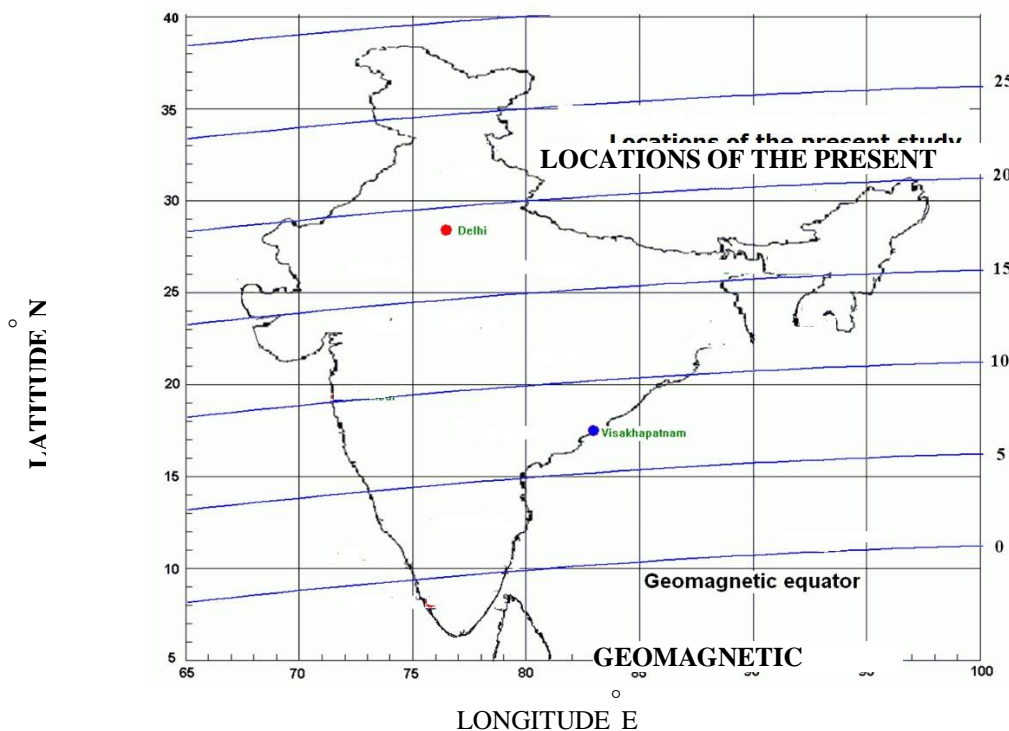


Fig.1 The data stations on India map

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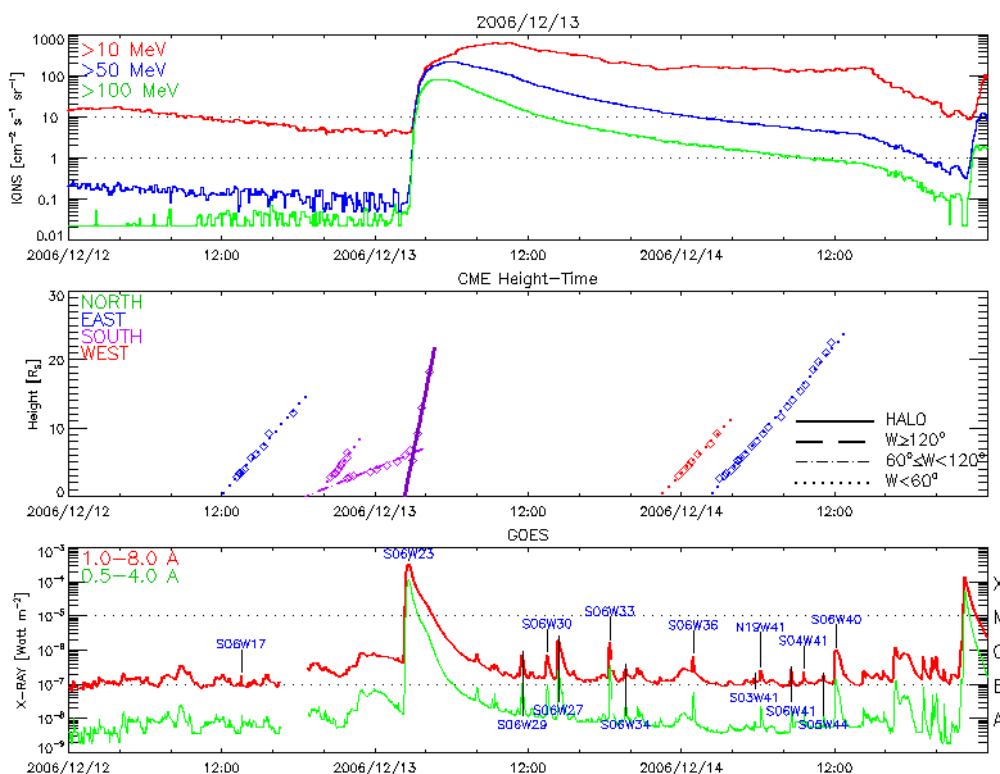
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## III. DISCUSSION

To observe the interplanetary variations of this storm the data of solar wind velocity, Ion temperature and IMF Bz data were collected from the website [http://ftpbrowser.gsfc.nasa.gov/ace\\_merge.html](http://ftpbrowser.gsfc.nasa.gov/ace_merge.html) and the Dst and AE data was collected from the world data centre Kyoto <http://wdc.kugi.kyoto-u.ac.jp/dstae/index.html>. The magnetic Ap index and F10.7 solar flux data was taken from the <http://omniweb.gsfc.nasa.gov/form/dx1.html>.

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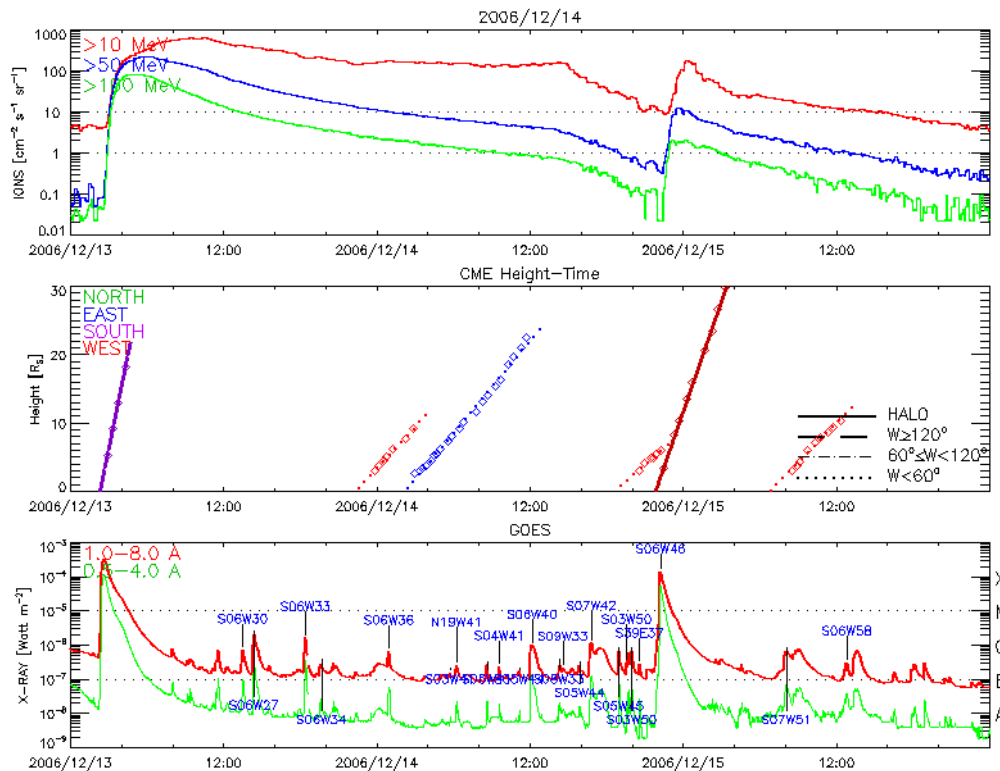


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**Fig.2. Occurrence of Solar Flare plot derived from NASA website**

The output variability of solar matter radiation and the magnetic fields associated with solar active regions is of considerable importance in the studies of aeronomy, meteorology, atmospheric physics, stellar and solar physics. The most commonly used indicators of solar activity are sunspots, flares, plagues and related phenomena. An important supplement to direct observations is a study of the behaviour of the Sun over long periods of time. This would be of great importance because the sunspot activity itself has been recognised as exhibiting a multiple periodicity over and above the 11 yr cycle, which extends to the duration of the record itself. Secondly, direct observations of solar electromagnetic processes are restricted to only a few sunspot cycles. From the Figure 1, it is observed that a strong solar flare was observed during which flux is suddenly increased from  $0.01-1 \text{ cm}^{-2} \text{ sec}^{-1} \text{ Sr}^{-1}$  to  $100-1000 \text{ cm}^{-2} \text{ sec}^{-1} \text{ Sr}^{-1}$  for the particles of (10-100MeV) of energy in the early hours of 13<sup>th</sup> December 2006. Simultaneously the heat flux density or irradiance is being increased to a higher value which resulted in an X class flare on the same day. The increase in the particle density can also be confirmed from the cosmic ray data measured from Kingston station which is the measure of number of primary particles at the same time i.e. in the early hours of 13<sup>th</sup> December 2006 which was presented in Figure 3.

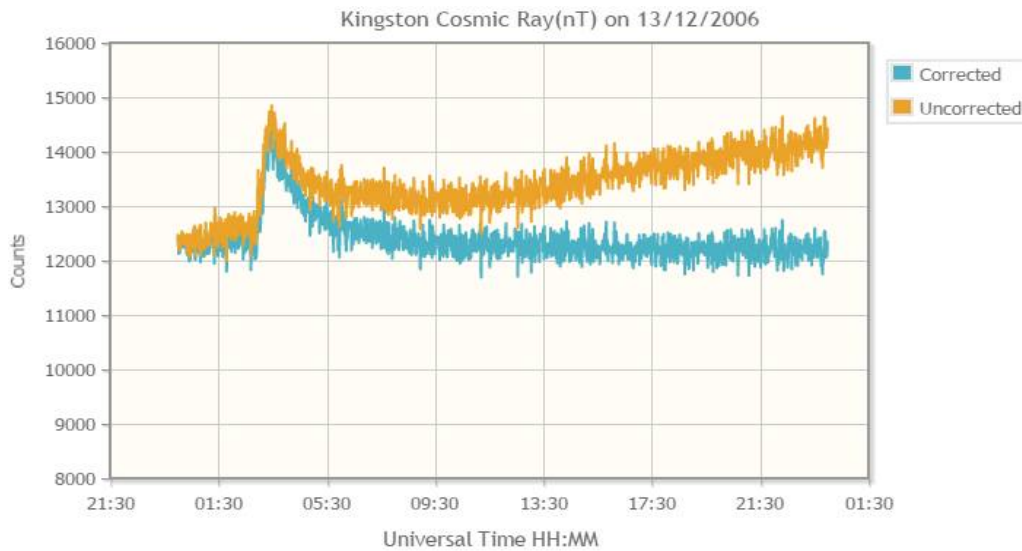
The global study of the atmosphere for the ionosphere indicates that it is highly variable from time to time season to season and solar cycles.

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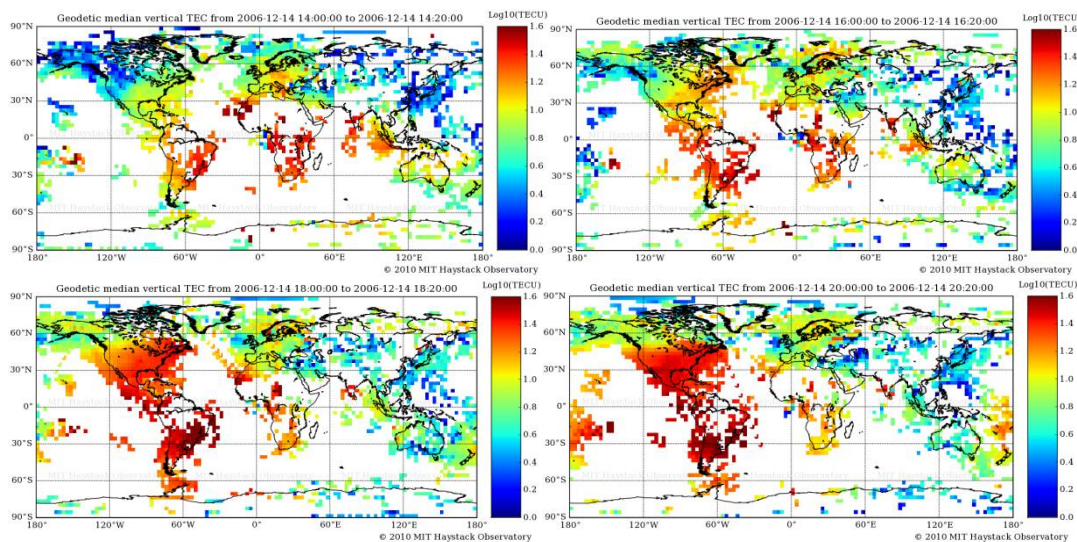
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**Fig.3. Particle count increase measurement from Kingston station (Cosmic rays)**

A perusal of the sequence of the global ionospheric TEC maps very clearly indicates widespread longitudinal-latitude changes in the TEC distribution with the development, associated with the dissipation into the ionosphere/thermosphere system of the solar wind energy deposited into the polar cap region (e.g. Ho et al., 1998).



**Fig.4. Latitudinal and longitudinal VTEC variations on storm conditions**

## V. SUMMARY AND CONCLUSIONS

The latitudinal and longitudinal behavior of the critical frequency, virtual height and most important parameter like TEC were studied and presented in this paper. The occurrence of geomagnetic storm on the presence of an X-class flare was observed in the present study.



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