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This paper presents a study of Ionospheric response on Magnetic storm impact on radar system in 3 November and 4 November. On November 4th, 2015 secondary air traffic control radar was strongly disturbed in Sweden and some other European countries. We studied disturbance in ionosphere (D_I) (Africa –Asia – Australia – South America) on 3 November and 4 November 2015.

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I. INTRODUCTION

Solar activity is the main source for disturbances of the geomagnetic field, which results in perturbations of the ionosphere, a layer of the earth's atmosphere with a high concentration of free electrons and ions. These disturbances are known to disturb technological system (i.e., communication systems and navigation, generators, power lines and transformers, satellites, etc.), in various degrees, depending on the intensity of the ionospheric storm, technological awareness and geomagnetic location of the system. (Araujo-Pradere, 2015)
The ATC (Air traffic control) Radar system divide into two types [1] - PSR are primarily set up at or near airports and generally operated worldwide either in L band (1215–1350 MHz) or S band (2700–3100 MHz). [2] - Secondary Surveillance Radars (SSR) send coded queries to transponders aboard aircraft and get in return ancillary information on the plane: identification, barometric altitude of the aircraft and for some systems, selected technical parameters. (Nava, 2016)

1.1 Data and analysis

In Sweden and Belgium, Solar storm made every plane disappear on radar screens. The aim of this choice is to evaluate disturbances in the ionosphere (D_I) over Over (Africa –Asia – Australia – South America) on 3 November and 4 November 2015. The period of interest starts on 3 November and until 4 November 2015. Disturbance of ATC Radar: Two periods of time (14:19 -14:34 UT) and (14:47-14:49) UT. The metrological data were storage for 4 stations from web site (http://www.intermagnet.org/).It shows average of disturbance in ionosphere over (Africa, Asia, Australia, South America) And Solar parameters (Sym-H, KP index, BZ, AU)

The process to separate D_I from the magnetic data is given by:

$$D_I^H = H - H_0 - S_R^H - D_M \qquad (1)$$

Where D_I^H is the disturbance D_I derived from the horizontal component (H) of the Earth's magnetic field; H_0 is the magnetic field component due to the Earth's external core dynamics, S_R^H is the daily quiet regular variation of H due mainly to the Sq system, and D_M represents the disturbances coming from the magnetosphere. We use the SYM-H index and the dip latitude ϕ to normalize the effect of the ring current at each station as follows:

$$D_M = SYM\text{-}H \cdot \cos\phi \qquad (2)$$

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The S_R^H is computed using the four geomagnetically quietest days before the storm with KP<2+ and it is derived by means of:

$$S_R^H = \frac{1}{n}\sum_{i=1}^{n}(H_i - D_i^H) - H_0 \qquad (3)$$

Where N is the number of the quiet days used, H_I is the H field component, and $D_I H$ the disturbances due mainly to magnetosphere D_M and ionosphere D_I.

Table 1: List Of Stations Used In Study First Column is Name of Station, Second Column is Co-latitude, And Third Column is Longitude And Fourth Is Elevation

Name of Station	Co-latitude	Longitude	Elevation
Tsumeb (TSU)	109.202°	17.584°	1100 meters
Charters Towers (CTA)	110.1°	146.3°	370 meters
Yakutsk (YAK)	28.04°	129.66°	100 meters
Huancayo (HUA)	102.05°	284.67°	3313 meters

II. RESULT AND DISCUSSION

The characterization of disturbance in ionosphere from 3 November to 4 November 2015 presented in this study.

In figure (1), we see (SYM-H) connote to the sudden storm commencement happened during time 8 AM (UTC) in 3 Nov and main phase is decrease in horizontal magnetic field happened between time 13:30 to 15:00 UTC.kp reached to kp5 (minor storm) on 3 Nov 2015 and reach to Kp5 again in 4Nov. The reflection of Bz happened about 7 Am (UTC) for 3Nov.Vp on 3Nov increased from 550 Km/s and 4Nov reached to 680 Km/s. The Au index reached on 4Nov 2015 to -2300 (NT). In figure (2), shows the storm sudden commencement happened about 8 UTC in 3NOV 2015 and the main phase to decrease in horizontal magnetic field intensity during time 13:30 to 15:00 UTC In figure (3), we can observed the storm sudden commencement event about 8 UTC and shows decrease in horizontal magnetic field intensity same time hits ATC radar system over Sweden region.In figure (4), we see the premier phase of storm happened about 8 UTC and we can observe the main phase happened from 13:30 to 15:00 UTC. In figure (5) we find the SSC appeared about 8 UTC and another SSC happened approximately 16 UTC in 3NOV and the main phase decrease in horizontal magnetic field ferocity in 4NOV during time 13:30 to 15:00 UTC.

In figure (6) we see the average of storm sudden incipience all continents about 8 UTC in 3NOV2015 and shows decease in horizontal magnetic field intensity from 13:30 until 15:00 UTC.

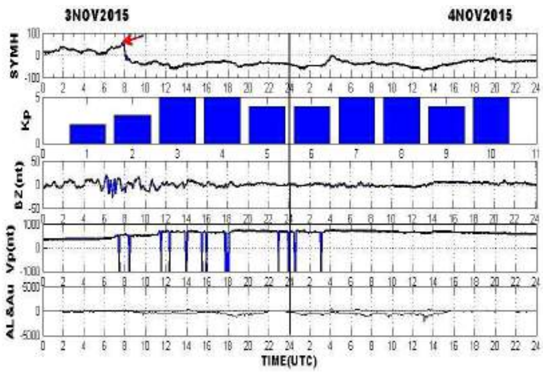

Figure 1: the solar parameters from [3NOV to 4NOV] 2015 from upper panel to lower panel, the solar wind (Vx), Aurora index (AU&AL), the Z component magnetic field (Bz), the planetary index (Kp), the (SYM-H) geomagnetic index.

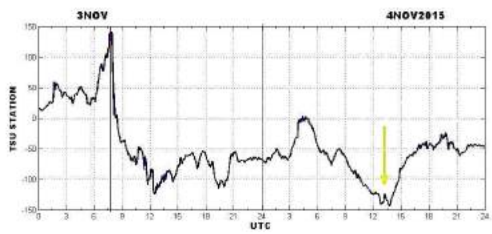

Figure 2: The disturbance in Ionosphere (D_I) TSU Station over Afric

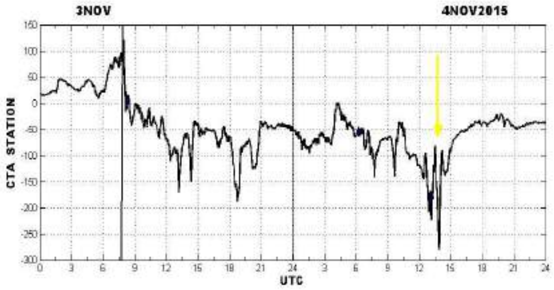

Figure 3: The disturbance in ionosphere (D_I) CTA Station over Australia.

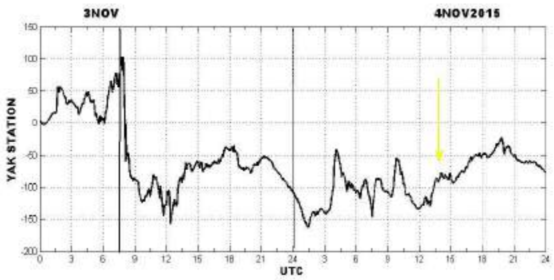

Figure 4: The disturbance in ionosphere (D_I) YAK station over Asia

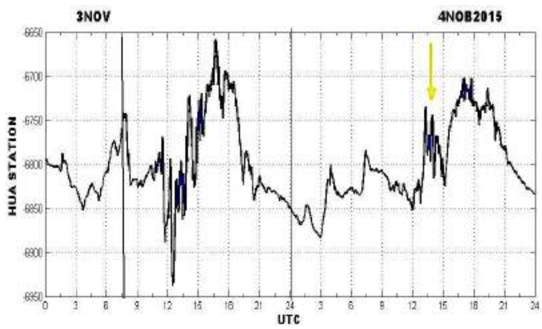

Figure 5: The disturbance in ionosphere (D_I) HUA Station over South America

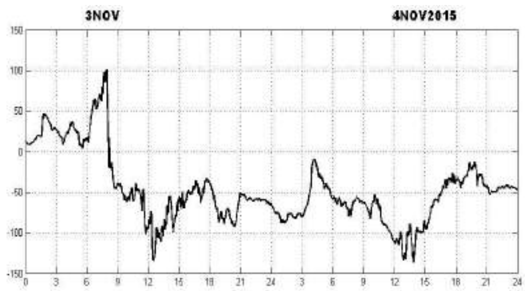

Figure 6: The average of disturbance in ionosphere (D_I) at all stations.

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