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Space Research at the University of Ilorin, Ngeria.

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Introduction.

Ilorin (8.5^{o}N, 4.5^{o}E, Dip, 1.7^o, 375m amsl) is located in the middle belt of Nigeria. Space research in Ilorin can be broadly categorized under two headings: Magnetic field and Ionospheric parameters measurements for Space weather applications.

Magnetic field Measurements and University of Ilorin.

Magnetic measurements are done in collaboration with Space Environment Research Centre, SERC, Kyushu University, Japan under the International Heliophysical Year 2007 (IHY 2007) and the UN Basic Space Science program. The SERC in collaboration with the University has installed a Flux Gate Magnetometer for the measurements of H, D, Z, of the earth's magnetic field. The magnetometer was successfully installed between the 24th and 29th of March, 2010. Prof. Kiyohumi Yumoto is the Director of SERC and Principal Investigator of the MAGDAS project.. Details on SERC and MAGDAS can be found at www.serc.kyushu-u.ac.jp

Installation

The installation team was made of three scientists from SERC and University of Ilorin. The SERC team was led by Engr. George MAEDA while the University of Ilorin Team was led by Dr. I. A. Adimula, Fig.1.

Fig. 1: Installation team of the University of Ilorin and SERC. Japan side:

G. Maeda (necktie), Y. Yamazaki (blue tee-shirt), A. Ikeda (black tee-shrit).

Figs.2 and 3 are the magnetometer sensor and Dr. Akihiro Ikeda making final adjustment to the sensor head.

Fig. 2: Magnetometer sensor.

Fig.3: Final Adjustments to the Magnetometer Sensor

Fig. 4 is the data logging and transmitting unit of the magnetometer.

Fig. 4: The Data logging and Transmitting Unit of the Magnetometer

Measurements

The Magnetometer and Digisonde transmit near real time data every second and every fifteen minutes respectively. The two equipments provide opportunity for simultaneous measurements of the magnetic elements and Ionospheric parameters for the study of Equatorial Electroject, magnetic storms effects on the Equatorial Ionosphere, equatorial scintillation, Global Navigation Satellite Systems, etc, at the same location. In addition the MAGDAS networks allows modeling of 3-D current system and the ambient plasma density for the understanding of the geospace plasma.

Fig. 5 is the magnetic field measurements for the period 01 to 10 April, 2010, the measurements show the magnetic storm of the 5th of April, 2010. Simultaneous measurements were made with the Digisonde.

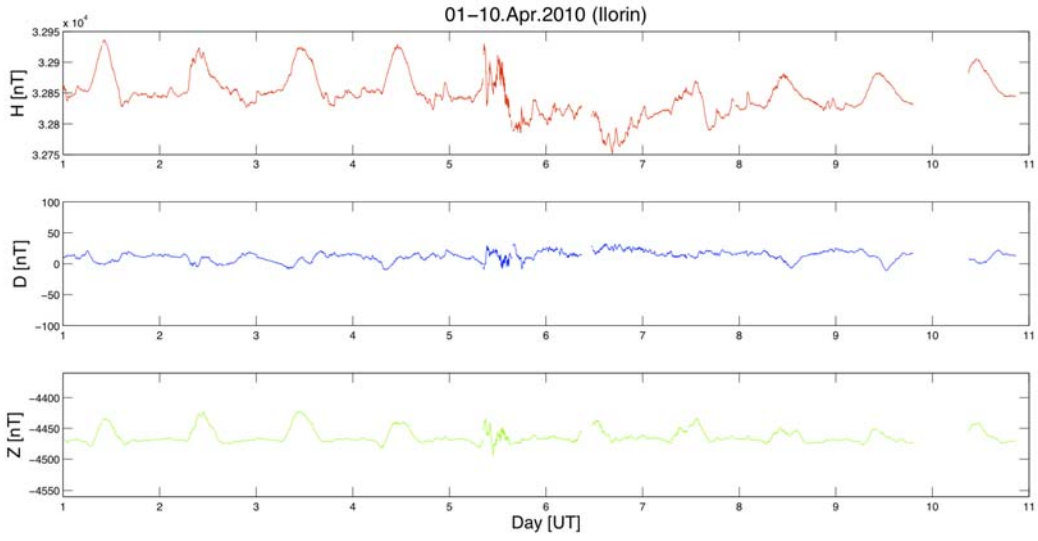

Fig. 5: Magnetic field elements records at Ilorin, Nigeria.

Ionospheric Measurements using DPS 4 Digisonde at University of Ilorin.

Digisonde Portable Sounder (DPS_4) was successfully installed at Ilorin, between 21st and 31st of March, 2010. The equipment was given on a long-term loan basis for collaborative research between US Air Force Academy (USAFA) and Department of Physics, University of Ilorin, Nigeria.

The process of collaboration was facilitated by Prof. Bodo W. Reinisch of University of Massachusetts, Lowell, Center for Atmospheric Research (UMLCAR). DPS_4 (Fig 6) is a low power miniature version of Digisonde from UMLCAR. The description of the equipment and software on it can be found at http://umlcar.uml.edu/digisonde.html. The design is in such a way that DPS_4 transmits radio signal using delta antenna (Fig. 7) and receive the down coming signal (reflected signal) from the ionosphere using a set of four crossed magnetic loop turnstile antennas (Fig. 8). The arrangement of the four crossed magnetic loop turnstile antennas is shown in figure 4. The arrangement of these antennas makes the digisonde capable of making simultaneous measurement of seven (7) observable parameters of the reflected signals received from the ionosphere. These observable parameters are:

1. Frequency
2. Range
3. Amplitude
4. Phase
5. Doppler shift and spread
6. Angle of Arrival
7. Wave Polarization

All these provide opportunity of studying the ionosphere in great detail.

Fig.6: Portable Digisonde Sounder

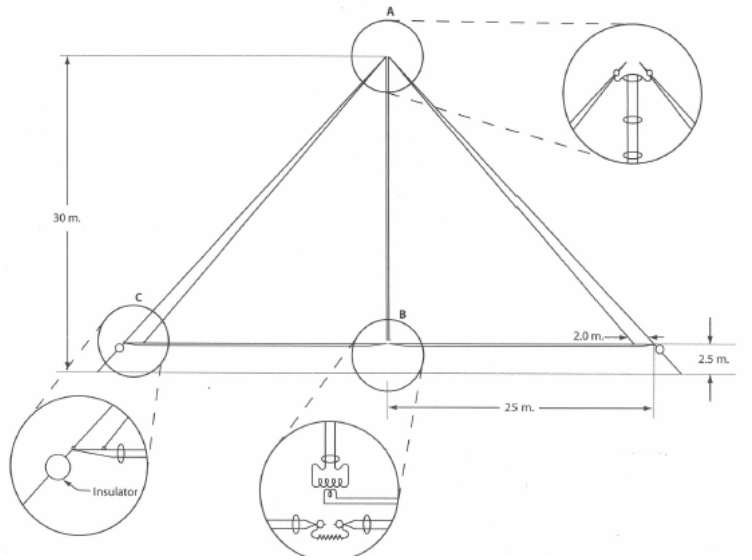

Fig. 7 is the Schematic Diagram of the Antenna system for DPS 4

Some sample measured quantities are shown in figures 8 to 13 corresponding to period of the Initial, storm time and recovery phases of the a magnetic storm.

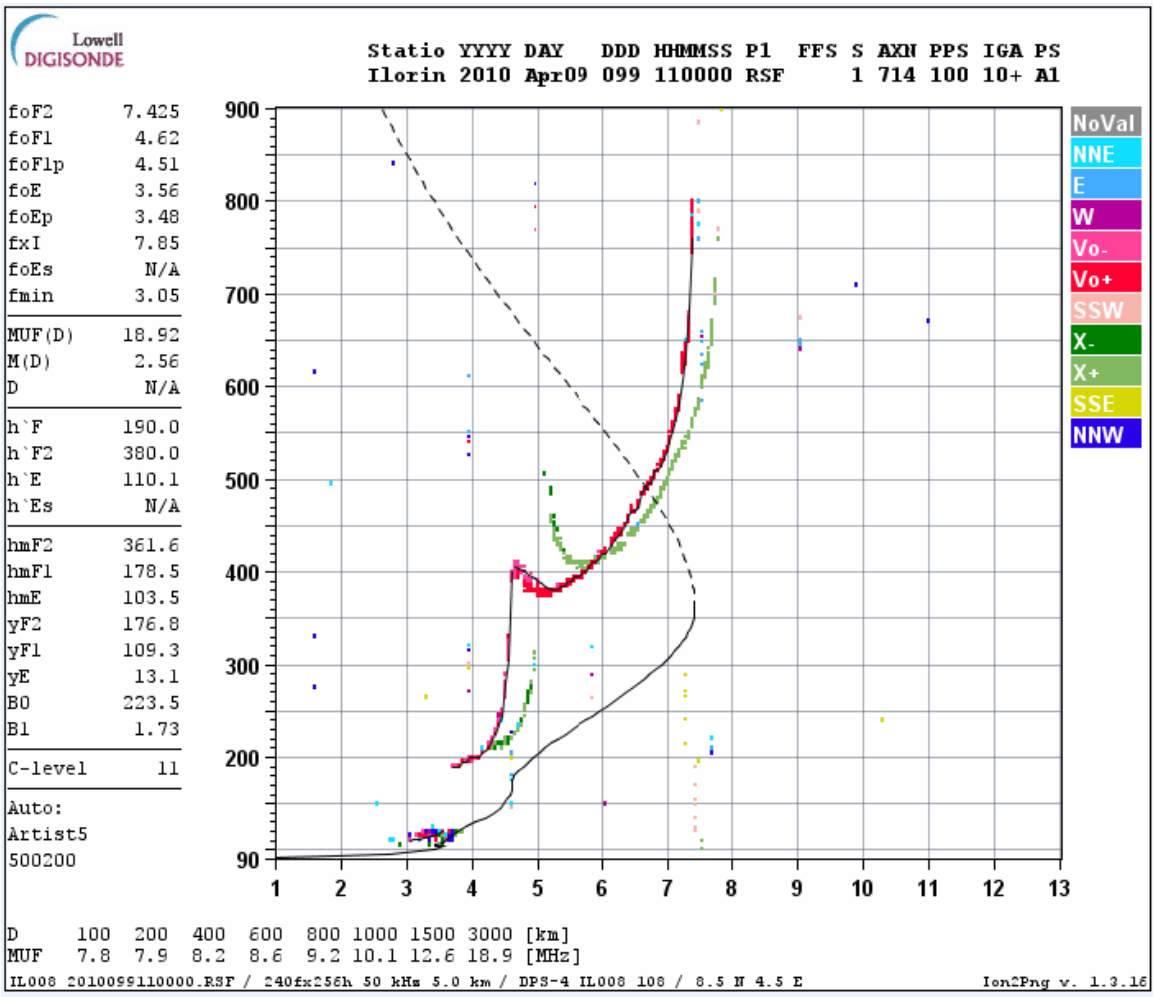

Figure 8 Sample Ionogram with Automatic Scaling

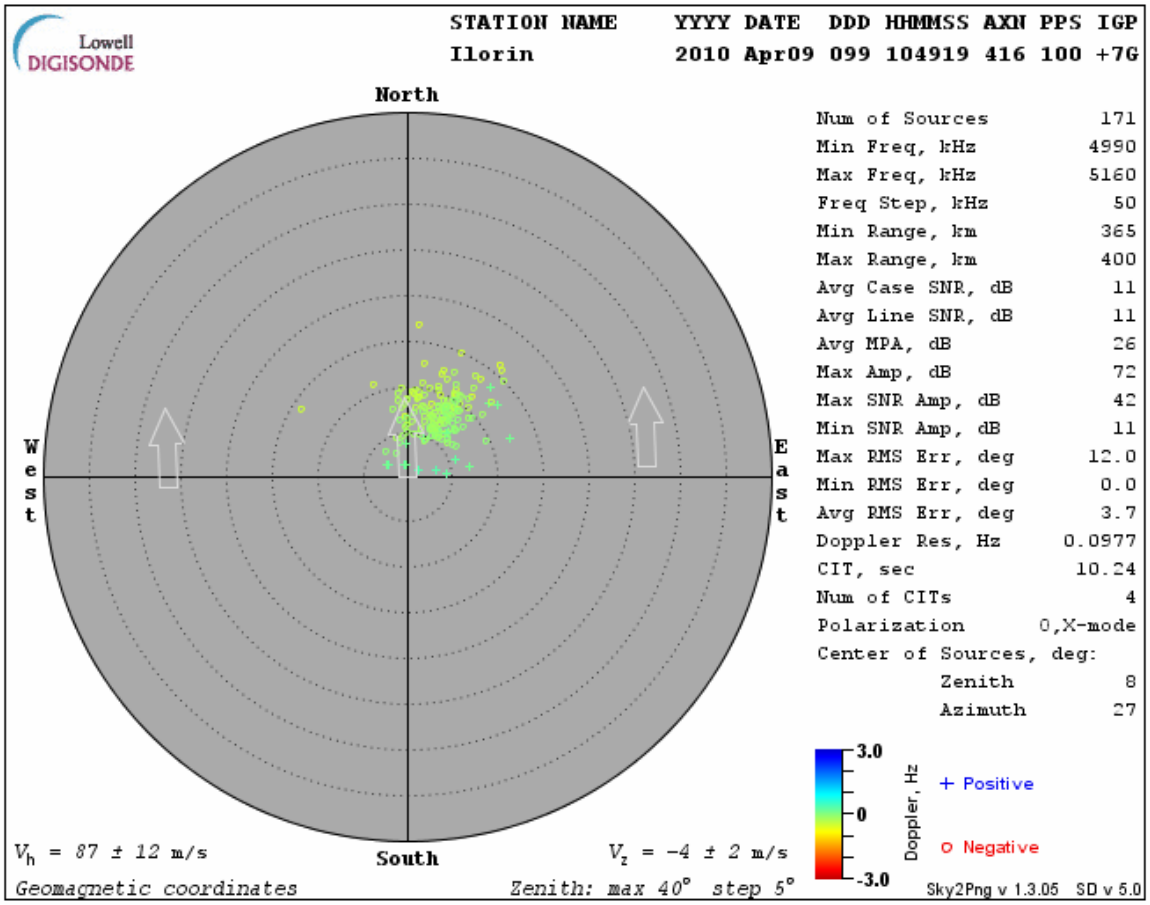

Figure 9 Sample Sky map

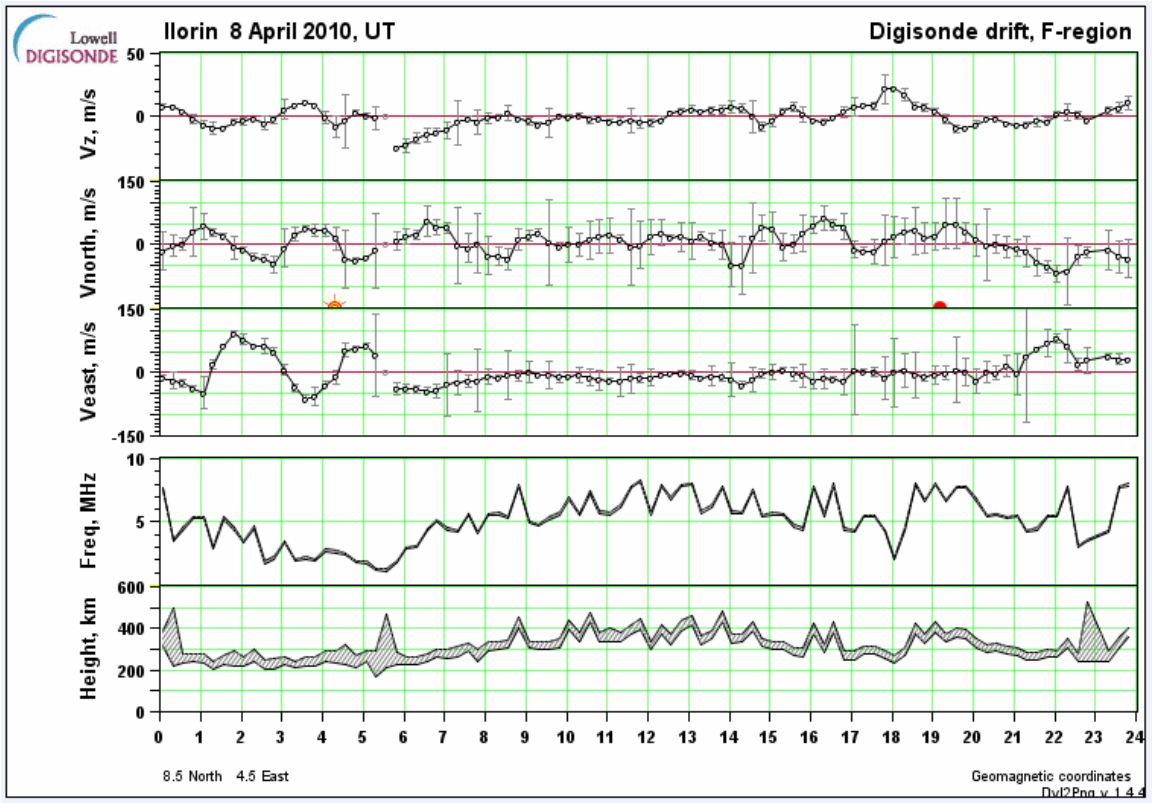

Figure 10 Sample Drift plot

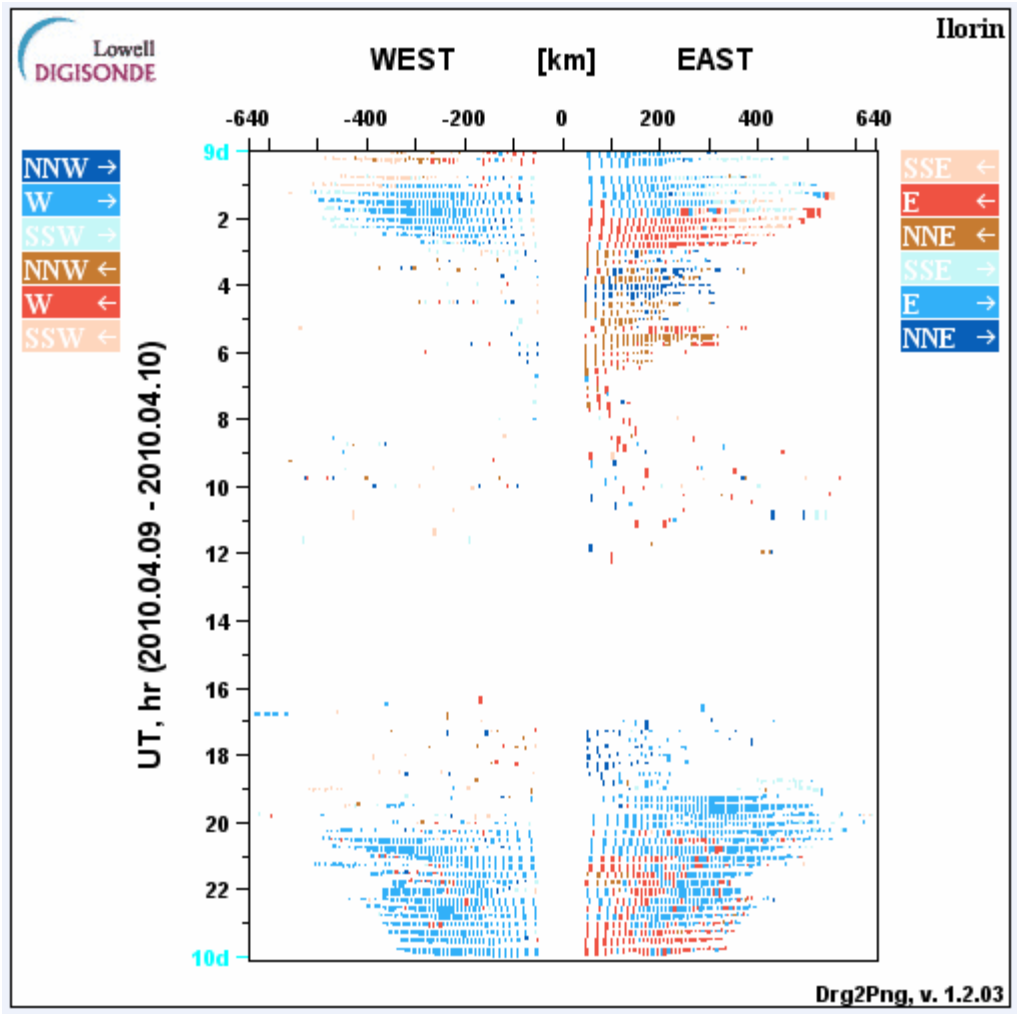

Figure 11 Sample Directogram