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ANALYSIS OF DISTURBANCE STORM TIME INDICES

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ABSTRACT

One of the energy sinks during Solar Wind Magnetosphere Ionosphere (SW-M-I) system is ring current injection rate, and this energy rate depends on the Disturbance Storm Time (DST). In this paper data from World Data Centre Kyoto (WDC) obtained at International Service for Geomagnetic Indices (ISGI) was used in this studies and International Association for Geomagnetism and Aeronomy (IAGA-2002) format was adopted in the analysis. Results obtained shows that the DST indices varies with time which indicate that proper monitoring of geomagnetic indices is required for accurate energy estimates.

Keywords and Phrases: *Energy Sinks, Ring Current Injection Rate, Disturbance Storm Time, Indices*

INTRODUCTION

In the process of energy transfer from the solar wind magnetosphere system, there is a corresponding means of energy dissipation, which include joule heating energy, energy via precipitation and ring current injection that result to magnetic disturbance when interact with earth's magnetic field. The activity of the ring current as a major form of magnetic disturbance is observe by an index known as Disturbance Storm Time (DST) which is a measure in the context of space weather. It gives information about the strength of the ring current around earth caused by solar protons and electrons. The ring current around earth produces a magnetic field that is directly opposite Earth's magnetic field, i.e. if the difference between the solar electrons and protons gets higher, and then Earth's magnetic field becomes weaker (Kivelson*et al*,, 1995). In an attempt to understand disturbance storm time, Gannon (2011) produced a1-mintime resolution Storm-Time Disturbance index, the USGSDST, called DST. The index was based on minute resolution horizontal magnetic field intensity from low-latitude observatories in Honolulu, Kakioka, San Juan and Hermanus, for the years1985–2007.The method used to produce the index was based on combination of time and frequency-domain techniques, which more clearly identifies and exercises solar quiet variation from the horizontal intensity time series of an individual station than the strictly time domain method used intheKyotoDSTindex.TheUSGS1-min DST was compared against the Kyoto DST, Kyoto Sym-H, and the USGS 1hDST(DST). They concluded that, in a time series comparison, Sym-H was found to produce more extreme values and account the variation from the difference in latitude between the observatories. Both Kyoto indices are shown to have a peak in their distributions below zero, while the USG S indices have a peak near zero.

Anh (2005) Provide a method to predict magnetic storm events based on the time series of the DST index over the period 1981–2002. The method is based on the multiple scaling of the measure representation of the DST time series. The measure is modeled as a recurrent iterated function system, which leads to a method to predict storm patterns included in its attractor. Numerical results are provided to evaluate the performance of the method in outside-sample forecasts. Caswell (2014) used a nonlinear autoregressive approach with exogenous input as a novel method for statistical forecasting of the disturbance storm time index, a measure of space weather related to the ring current which surrounds the Earth, and fluctuations in disturbance storm time field strength as a result of incoming solar particles. Given the occurrence of solar activity hours or days before subsequent geomagnetic fluctuations and the potential effects that geomagnetic storms have on terrestrial systems, it would be useful to be able to predict geophysical parameters in advance using both historical disturbance storm time indices and external input of solar winds and the interplanetary magnetic field. By assessing various statistical techniques, he determined that artificial neural networks may be ideal for the prediction of disturbance storm time index values which may in turn be used to forecast geomagnetic storms.

Unlike the above methods, in this work 2015 and 2016 hourly provisional data values from World Data Centre Kyoto (WDC) obtained at International Service for Geomagnetic Indices (ISGI) is used, and International Association for Geomagnetism and Aeronomy (IAGA-2002) format will be adopted in the analysis

MATERIALS AND METHOD

Materials

Data Source

The data used in this research, was obtained from World Data Center (WDC) for Geomagnetism, Kyoto, Japan and converted to IAGA-2002 format by the International Service of Geomagnetic Indices (ISGI) hourly provisional data values were used for 2015 and 2016

Method

The hourly provisional indices for 2015 and 2016 were converted to mean hourly-daily geomagnetic index as follow to reduce the clusters of data. To minimize error in dealing with a cluster of 1h-cadre of data we centralized them to source K, such that: if x0, x1, x2, x3,...x23, are the hourly geomagnetic indices for a day, then

$K = \frac{\sum_{i=0}^{23} X_i}{n}$ (3.0) Where K is the mean hourly-daily geomagnetic indices and used it to make the analyses.

Data Analysis

The mean hourly disturbance Storm time obtained from equation 3.0 was used as an input to Microsoft excel spread sheet for analysis. The analysis was carried out first for the year 2015 followed by 2016.

RESULT AND DISCUSSION

Results

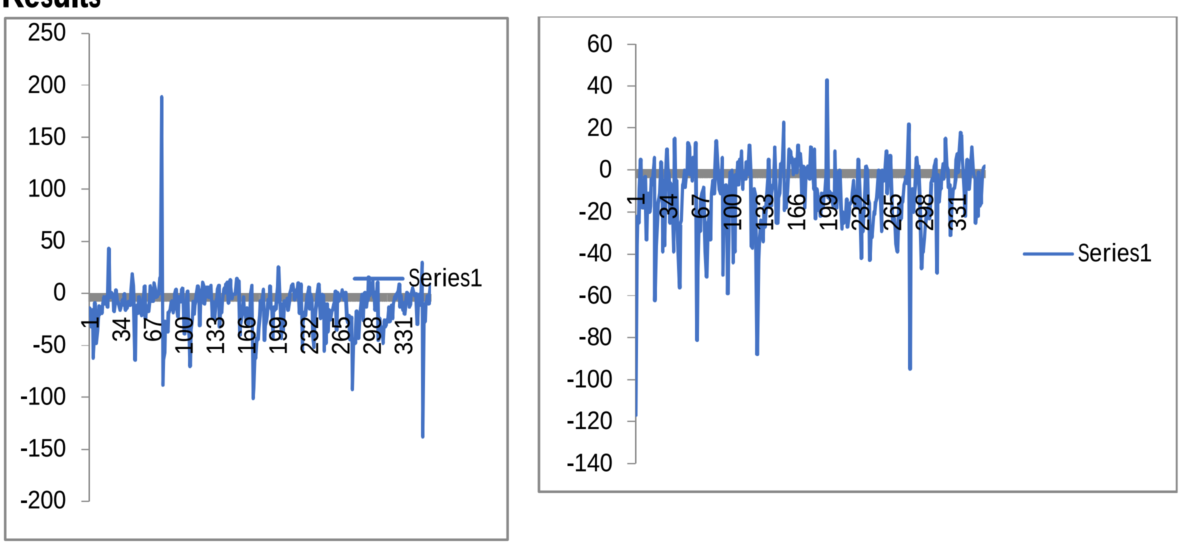

Figure 1: Graphical representation of 2015 and 2016, Disturbance Storm Time

DISCUSSION

In the above figure, the disturbance happens to be negative at the middle and at the end of 2015, this means that, the DST index are negative, reflecting the westward drift of the energetic, positively charged ions produced during the storm and carrying a westward directed electric current, the same thing happen about 100 days and toward the end of the year (2016). At the 120days days and 270th day of 2016, the DST is negative which means it reflects some of it charges.

Unlike the case where DST is positive at the 80th day of 2015 and 20th day of 2016 the charged storm cannot carry westward electric current. But when DST is Zero in both the figures it is indicating the weakness of the earth magnetic field which happen during the early days of 2016, but more frequently during 2015.

CONCLUSION AND RECOMMANDATION

CONCLUSION

This studies show that the Disturbance Storm Time (DST) varies with time, day by day and month by month which clear indicates that the ring current injection as one of the energy sinks varies. This is consistent with many results that the earth magnetic field is not constant.

RECOMMANDATION

Variation of earth magnetic field is not constant due to the magnetic field of the atmospheric ring current which changes month to month and year to year. Therefore there is need for more research so as to know how to prevent the effect of geomagnetic storm on infrastructure

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