Geomagnetic Storm Related to Disturbance Storm Time Indices

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ABSTRACT

The magnitude of the Disturbance Storm Time (Dst) index varied in relation to the extremely small negative integer that indicated a large geomagnetic storm. The large sharpened variants of negative Dst indices could describe the detailed features of a geomagnetic storm. The Dst index was estimated using an algorithm through time and frequency-domain band-stop filtering to remove the solar-quiet variation and the mutual coupling effects between the Earth’s rotation, the Moon’s orbit, and the Earth’s orbit around the Sun. A good geomagnetic model that could describe the true variations in the geomagnetic field when undergoing diverse space weather, and one that could even predict variations in the geomagnetic field with a high accuracy. A suitable temporal resolution for the Dst index was per hour.

Keywords: Disturbance Storm Time (Dst) index, Geomagnetic Storm, Solar-Quiet Variation, Earth’s Rotation, Moon’s Orbit, Earth’s Orbit.

I. INTRODUCTION

The Disturbance Storm Time (Dst) index was a physical quantity unit of NanoTesla (nT). One NanoTesla was equal to $10^{-9}$ Tesla, and one Tesla was equal to one weber per square meter (Wb/m^2). The magnitude of the Dst index varied in relation to the extremely small negative integer that indicated a large geomagnetic storm shown in Fig.1. Thus, the large sharpened variants of negative Dst indices could describe the detailed features of a geomagnetic storm [1]-[4]. They also indicated when the solar wind has pushed the boundary of the magnetosphere and the conditions of the magnetopause and magnetic tail, inside the geosynchronous orbit [5][13]. Simultaneously, they could also clearly record the arrival times of geomagnetic storms [14]-[16]. The Dst index was estimated from the measurements obtained at stations based on the International Real-time Magnetic Observatory Network (INTERMAGNET) [17].

II. DISCUSSION

Since 1975, the Geostationary Operational Environmental Satellite system (GOES system) has been used to monitor space weather. The GOES magnetometers of GOES system were used to monitor the Earth’s magnetosphere during geomagnetic storms [5], [19]. The GOES system was built by the United States National Oceanic and Atmospheric Administration (NOAA). It could support weather forecasting, severe storm tracking, and meteorology research connected with ground-based receiver stations, such as ground-based magnetometer stations, and could provide a continuous stream of environmental data, including the parameters of space weather, e.g., the Dst index. The Dst index was derived from hourly scalings of the horizontal magnetic variation, which indicated the effect of the globally symmetric westward-flowing high-altitude equatorial ring current [2], [20], so the ring current depressed worldwide in the horizontal component of Earth’s magnetic field with hourly H-component magnetic variations, especially during large magnetic storms. After that, the Dst index was estimated using an algorithm through time and frequency-domain band-stop filtering to remove the solar-quiet variation and the mutual coupling effects between the Earth’s rotation, the Moon’s orbit, and the Earth’s orbit around the Sun [21], [22]. In order to build a good geomagnetic model that could describe the true variations in the geomagnetic field when undergoing diverse space weather, and one that could even predict variations in the geomagnetic field with a high accuracy. Then, a suitable temporal resolution for the Dst index was per hour. However, the geomagnetic model must be able to describe a more accurate characterization of the local auroral absorption rather than the general global state with higher temporal resolution, as it was an important area (auroral area) of research [23], [24].

III. CONCLUSIONS

The magnitude of the Dst index varied in relation to the extremely small negative integer that indicated a large geomagnetic storm. The large sharpened variants of negative Dst indices could describe the detailed features of a geomagnetic storm. The Dst index was estimated from the measurements obtained at stations based on the INTERMAGNET. The Dst index was derived from hourly
scalings of the horizontal magnetic variation, which indicates the effect of the globally symmetric westward-flowing high-altitude equatorial ring current, so the ring current depressed worldwide in the horizontal component of Earth’s magnetic field with hourly H-component magnetic variations, especially during large magnetic storms, a good geomagnetic model that could describe the true variations in the geomagnetic field when undergoing diverse space weather, and one that could even predict variations in the geomagnetic field with a high accuracy. Then, a suitable temporal resolution for the Dst index may be per hour.

Fig. 1. Plot of the Dst indices (unit nT) for July 2000 (UTC) The horizontal time scale from 1 to 2 indicates the variation in the Dst indices on 01 July 2000 as an example. The later figures with horizontal time scales are consistent with this scale on the horizontal axis, including those in the main text. The geomagnetic storm that occurred during this month during solar cycle 23 was named the Bastille Day event [18].

DATA AVAILABILITY
World Data Centre for Geomagnetism, Kyoto.

ACKNOWLEDGMENTS

The author is also grateful the supporting of Prof. Dr Yuan Mei in Taiwan and all of my friends in Taiwan and China

CONFLICTS OF INTEREST
The author declares that there is no conflict of interest.

AUTHOR CONTRIBUTIONS
designed the research; performed the research; analyzed the data; and wrote the paper.

REFERENCES

DOI: http://dx.doi.org/10.24018/ejgeo.2021.2.6.199

Vol 2 | Issue 6 | November 2021


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