Brief Introduce of Planetary K-index: An Indicator of Geomagnetic Storms

Jyh-Woei Lin

ABSTRACT

The planetary K-index (Kp index) was a geomagnetic index in the H-component field. This index was calculated from data collected by a network of 13 ground-based magnetometer stations at mid-latitude locations from the International Real-time Magnetic Observatory Network (INTERMAGNET). The magnitudes of Kp index could indicate geomagnetic activity using the integer K-scale from 0 to 9 without dimension because the K-scale was estimated using the quasi-logarithms algorithm. The Kp index indicated geomagnetic storms under the condition of K-scale > 4 . The three-hourly Kp index has been commonly used. The three-hourly Kp index was relatively stable for low-variability geomagnetic activity. The hourly Kp index represented the level of auroral absorption with a more accurate characterization. For future research, the Kp index with a high sampling rate (e.g., < 1 hour) could be considered, so that a very accurate characterization was characterized the more detailed geomagnetic activity of global region.

Keywords: International Real-time Magnetic Observatory Network (INTERMAGNET), Geomagnetic Storms, K-scale, Low-Variability Geomagnetic Activity, Quasi-logarithms Algorithm, Planetary K-index (Kp index).

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I. INTRODUCTION

The planetary K-index (Kp index), which was a geomagnetic index in the H-component field, was calculated from data collected by a network of ground-based magnetometer stations at mid-latitude locations from the International Real-time Magnetic Observatory Network (INTERMAGNET) [1] indicated that the magnitudes of geomagnetic activity could be characterized using the integer K-scale from 0 to 9 without dimension because the K-scale was quasi-logarithmic using the quasi-logarithms algorithm as shown in Fig. 1 and Table I [2]-[9].

II. AN INDICATOR OF GEOMAGNETIC STORMS

The Kp was an excellent indicator, which was used to decide whether geomagnetic alerts should be sent (World Data Center for Geomagnetism, Kyoto). The Kp index could describe the detailed features of a geomagnetic storm under the condition of K-scale > 4 shown in Table I. The three-hourly Kp index (sampling rate: per three hours) has been commonly used. For low-variability geomagnetic activity, the three-hourly Kp index was relatively stable, which could reflect the apparent characterization of the geomagnetic activity. Hence, determining the temporal resolution of the Kp index depended on the local dynamic characterization of the geomagnetic activity. The hourly Kp index provided a

more accurate characterization, which could represent the level of auroral absorption [10], [11]. For future research, the Kp index with a high sampling rate (e.g., < 1 hour) could be a good issue, so that a very accurate characterization was characterized the more detailed geomagnetic activity of global region.

Fig. 1. The Kp indices for July 2000 (UTC).
(Source: World Data Center for Geomagnetism, Kyoto).
The horizontal time scale from 1 to 2 indicates the variation in the Kp indices on 01 July 2000 as an example.

TABLE I: THE KP INDEX RELATED TO EARTH'S MAGNETIC FIELD

The value of Kp index	Description
0	Quiet – Aurora oval mostly to the north of Iceland. Faint aurorae visible in photographs, low in the northern sky.
1	Quiet – Aurora oval over Iceland. Faint and quiet aurorae visible to the unaided eye. low in the northern sky.
2	Quiet – Auroras readily visible; become brighter and more dynamic.
3	Unsettled – Bright auroras visible at zenith. Pale green color more obvious.
4	Active – Bright, constant, dynamic northern lights visible. More colors start to appear.
5	Minor storm – Bright, constant, colorful aurora display, red and purple colors appear. Aurora coronae likely.
6	Moderate storm – Bright, dynamic, colorful aurora display. Aurora coronae likely. Memorable to those who witness them.
7	Strong storm – Bright, dynamic, colorful aurorae. Visible in the southern sky. Aurora coronae very likely.
8	Severe storm – Bright, dynamic, colorful aurorae. Aurora seen around 50° latitude
9	Intense storm – Aurorae seen around 40° latitude. Red aurorae and coronae very likely. Most often caused by powerful coronal mass ejection

The Kp Index describes the disturbance of Earth's magnetic field caused by the solar wind. The faster the solar wind blows, the greater the turbulence. The index ranges from 0 (low activity) to 9, which indicates that an intense geomagnetic storm is under way. The information and definition of the Kp index are obtained from the Leirvogur Magnetic Observatory.

III. CONCLUSION

The Kp index was calculated from data collected by a network of 13 ground-based magnetometer stations at mid-latitude locations from the INTERMAGNET. This index was a geomagnetic index in the H-component field. The K-scale was estimated using the quasi-logarithms algorithm without dimension. The magnitudes of Kp index could indicate geomagnetic storms under the condition of **K-scale** > 4. The three-hourly Kp index has been commonly used because the three-hourly Kp index was relatively stable for low-variability geomagnetic activity. The hourly Kp index represented the level of auroral absorption with a more accurate characterization. For future research, the Kp index with a high sampling rate (e.g., <1 hour) could be a good issue, so that a very accurate characterization was characterized the more detailed geomagnetic activity of global region.

DATA AVAILABILITY

Source of the Kp indices: <http://wdc.kugi.kyoto-u.ac.jp/kp/index.html>.

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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.

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