

On a Relationship between Decreasing of Horizontal Intensity and Kp-Indices

By

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概 要

地磁気擾乱の際に水平分力の減少する現象について、1953～1958の柿岡に於ける観測値と Kp インデックスを用いて調査した。結果の概要は次の通りであつた。

1. 弱い擾乱の際も水平分力は減少する。
2. 減少の量は太陽黒点の多い時は少い時より大きい
3. 減少量は Kp の日合計が30を越えるあたりから急に大きくなる。
4. 擾乱による減少効果は数日続き、太陽黒点の多い時は少いときより長びく。

§ 1. Introduction

It is well known that the horizontal intensity decreases markedly during the main phase of magnetic storms. It is generally considered that this is caused by the westward electric current which is produced by solar particles trapped in the earth's dipole field and encircles the earth. The decreasing of horizontal intensity continues prolonged for several days.

From a study by monthly means of the horizontal component at Potsdam Ad. Schmidt suggested that the current never dies away completely and it must wax and wane as magnetic disturbance increases or decreases. In Fig. 1 are shown the monthly means of the horizontal intensity observed at Kakioka from 1955 to 1958 and the monthly means of daily sum of Kp-indices. Fig. 2 shows the means of the horizontal intensity and daily sum of Kp-indices for five international calm days during the

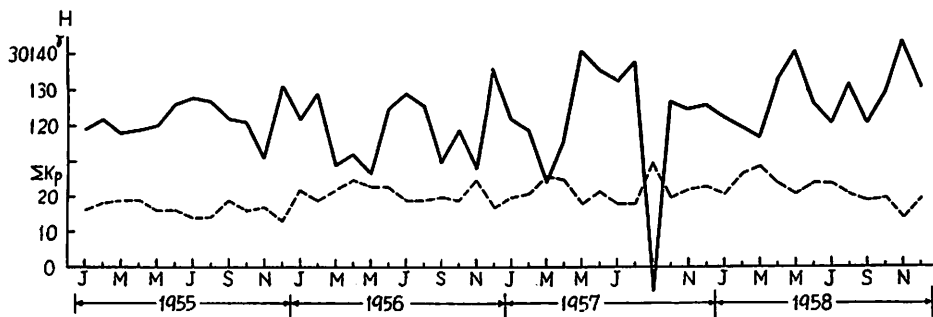


Fig. 1 Monthly mean values of horizontal intensity at Kakioka and daily sum of Kp-indices.

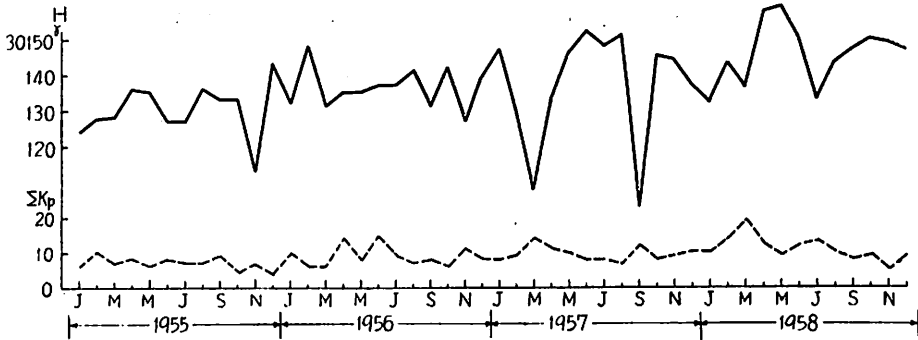


Fig. 2 Five international calm day's mean of horizontal intensity at Kakioka and daily sum of Kp-indices.

same period. Five calm day's mean of the horizontal intensity is changing with the same tendency as the monthly mean value. It looks likely that the horizontal intensity decreases during even slight disturbances.

In this short note the author wishes to report preliminarily the result of roughly estimation in the relation between magnetic activity and decreasing of the horizontal intensity.

§ 2. Investigation

Used data are Kp-indices and the horizontal intensity observed at Kakioka ($36^{\circ}14' N, 140^{\circ}11' E$) during the period from 1953 to 1958. The estimations were treated for three periods which are classified based on the sunspot number; large, middle and small years. Daily sum of Kp-indices are used for daily criterion of magnetic activity and denoted as ΣKp . For convenience the suffixes of Kp-indices; +, 0 and - are ignored.

Daily mean values of the horizontal intensity, corrected for the secular variation, are averaged for each ΣKp , and denoted as \bar{H}_n . The relation Kp and \bar{H}_n for the periods said above, 1953-1954, 1955-1956 and 1957-1958 are shown in Fig. 3(a); I (a), II (a) and III (a) respectively.

Based on the mean curves in Fig. 3(a) each daily mean value of the horizontal intensity is reduced to its hypothetical value when $Kp=0$ to eliminate the decreasing effect on the same day as that on which ΣKp is scaled. The relation between ΣKp and the mean of thus reduced values for the next day, of the day on which ΣKp is scaled, \bar{H}'_{n+1} , is shown in Fig. 3 (b); I (b), II (b) and III (b).

In same way, \bar{H}''_{n+2} are calculated, based on the mean curves in Fig. 3(b), for the day two days after for each ΣKp . The relation between ΣKp and \bar{H}''_{n+2} , is shown in Fig. 3 (c); I (c), II (c) and III (c).

A summary of investigation is shown in Table 1.

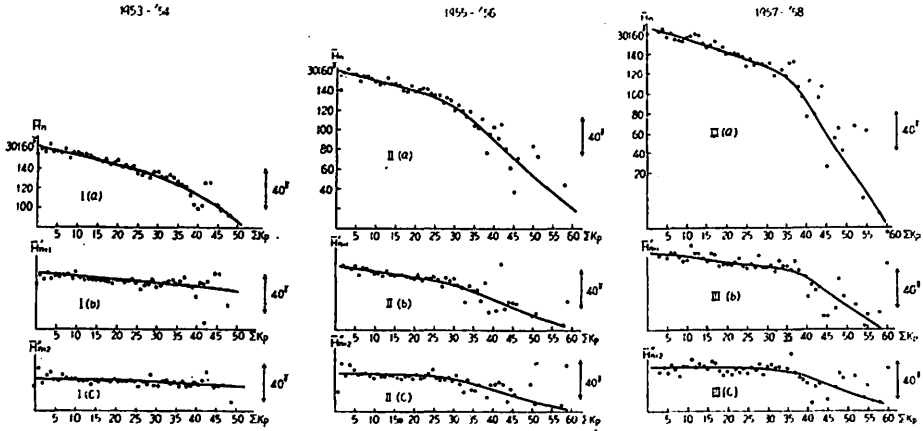


Fig. 3 The relationship between decreasing of horizontal intensity and daily sum of Kp-indices.
 (a) Daily sum of Kp-indices and daily mean of horizontal intensity on that day.
 (b) Daily sum of Kp-indices and daily mean of horizontal intensity of next day.
 (c) Daily sum of Kp-indices and daily mean of horizontal intensity of two days after.

Table 1 Relationship between decreasing of horizontal intensity and Kp

Year		1953—54		1955—56		1957—58	
Mean of Wolf number		9.2		89.9		186.8	
$\Delta \bar{H}_n / \Delta \Sigma Kp$	γ	a	b	a	b	a	b
		1.0	2.4	1.2	4.0	1.3	6.2
$\Delta \bar{H}'_{n+1} / \Delta \Sigma Kp$	γ	a	b	a	b	a	b
		0.3		0.6	1.7	0.7	2.7
$\bar{H}''_{n+2} / \Delta \Sigma Kp$	γ	a	b	a	b	a	b
		0.1		0.2	1.2	0.1	1.2

a : Kp is smaller than about 30

b : Kp is larger than about 30

§ 3. Conclusion

Results of investigation are as follows:

- (1) Magnetic horizontal intensity decreases during even slight disturbances.
- (2) $\Delta H/\Delta \Sigma K_p$ is greater in large sunspot years than in small years.
- (3) $\Delta H/\Delta \Sigma K_p$ becomes greater at about $\Sigma K_p=30$.
- (4) Decreasing life-time is longer in large sunspot years than small years.

The above-mentioned analyses are roughly estimations, and it is necessary to make more rigorous statistical investigation to get a more exact result. In near future the author wishes to report a more detailed investigation.

In conclusion the author thanks to Dr. T. Yoshimatsu, Director, Kakioka Magnetic Observatory for his encouragement.

Reference

Schmidt, A., Erdmagnetismus, Enzyklopädie der mathematischen Wissenschaften, Band VI, Leipzig, 1917.