Occurrence Frequency of Aurora Derived from ASCAPLOT

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ASCAPLOT による極光出現頻度の推測

中　村　純　二*

要　旨

1959 年及び 1960 年の Ascaplot に対し，簡単な統計をとって，昭和基地における極光の時間空間的出現頻度を求めた．極光は特に南方によく出現し，また真夜中以後に出易いが，著しい季節変化はない．1959 年のデータについては K 磁気指数との相関を調べ，K 指数と極光活動度が略比例すること，並びに K 指数の大きい場合，極光帯は低緯度側に拡がることが確かめられた．

Abstract

This paper reports on the occurrence frequency of aurora derived from ascaplots, observed at Syowa Station in 1959 and 1960. Aurora was frequently in the south and after midnight. The correlation between K index at Syowa Station (K_s) and auroral activity was also discussed.

1. Statistical Results: Fig. 1 shows the percentage of monthly occurrence in three

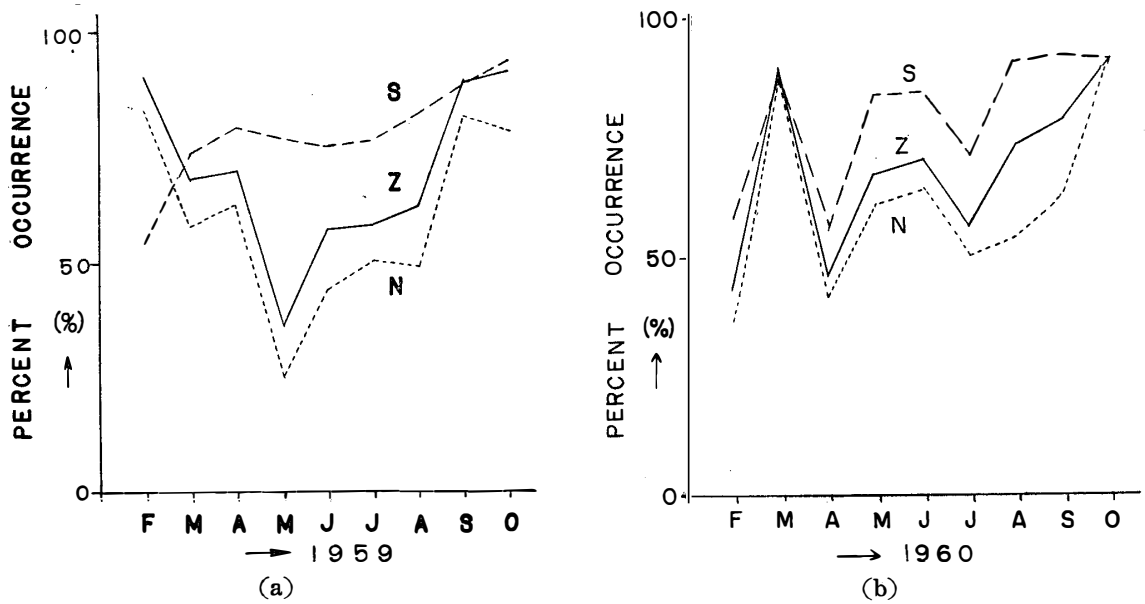

Fig. 1. Percentage of monthly occurrence in three regions of N, Z and S. a) in 1959, b) in 1960.

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regions of N, Z and S in 1959 and 1960. Data in February were deficient and the time of observation was limited to around midnight, hence the results are unreliable. Aurora appears more frequently in the south. In 1959, aurora was liable to appear in autumn and in spring, but in 1960 it appeared in winter also. The small frequency for winter may be due to the fact that observation in winter was carried out during the long evening time when aurora appeared only scarcely (Fig. 4). From this point of view, it may be concluded that aurora shows no distinct seasonal variation.

Fig. 2 shows the ratio of occurrence frequency of zenith intensity I : II : III. The ratio seems to be almost constant throughout the year. In 1959, slight maxima are found in April and in winter, and in 1960 maxima occur in April and August. From Figs. 1 and 2, it can be said that the larger the occurrence frequency, the stronger the auroral activity.

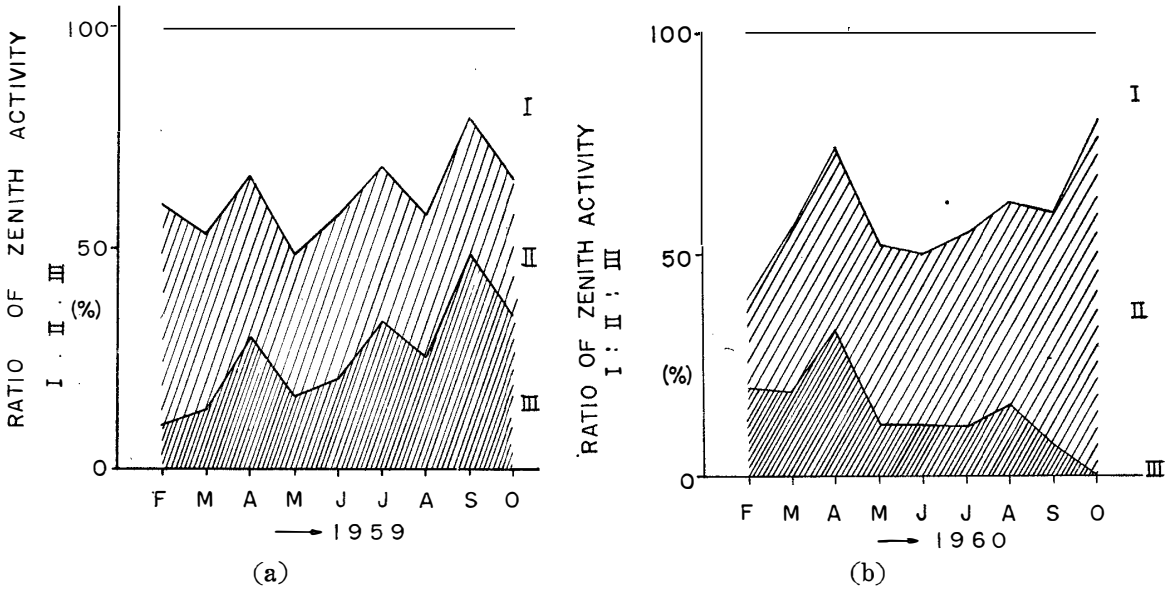

Fig. 2. Monthly mean ratio of zenith activity. Densely hatched area corresponds to activity III, hatched area to II and white area to I. a) 1959, b) 1960.

Fig. 3 shows the daily variations of occurrence frequency in three regions, N, Z and S. Most of aurora occurred after local midnight (about 21:00 U.T.) and were always more frequent in the south region than in the north region. In 1959 a maximum occurrence is seen between 21:00 and 00:00 U.T., while in 1960 it is seen at about 03:00 U.T.

Fig. 4 shows the three-hourly ratios of zenith activity I : II : III. The values of ratios are almost constant as in the case of seasonal variation. Slight maximum of activity may fall between 21:00 and 00:00 U.T. Auroral activity of 1959 is generally higher than that of 1960.

2. Correlation with K index at Syowa Station: We reduced three-hourly values from ascaplots and compared them with magnetic activity K_s, that is, the K-index at Syowa Station in 1959.[1)]

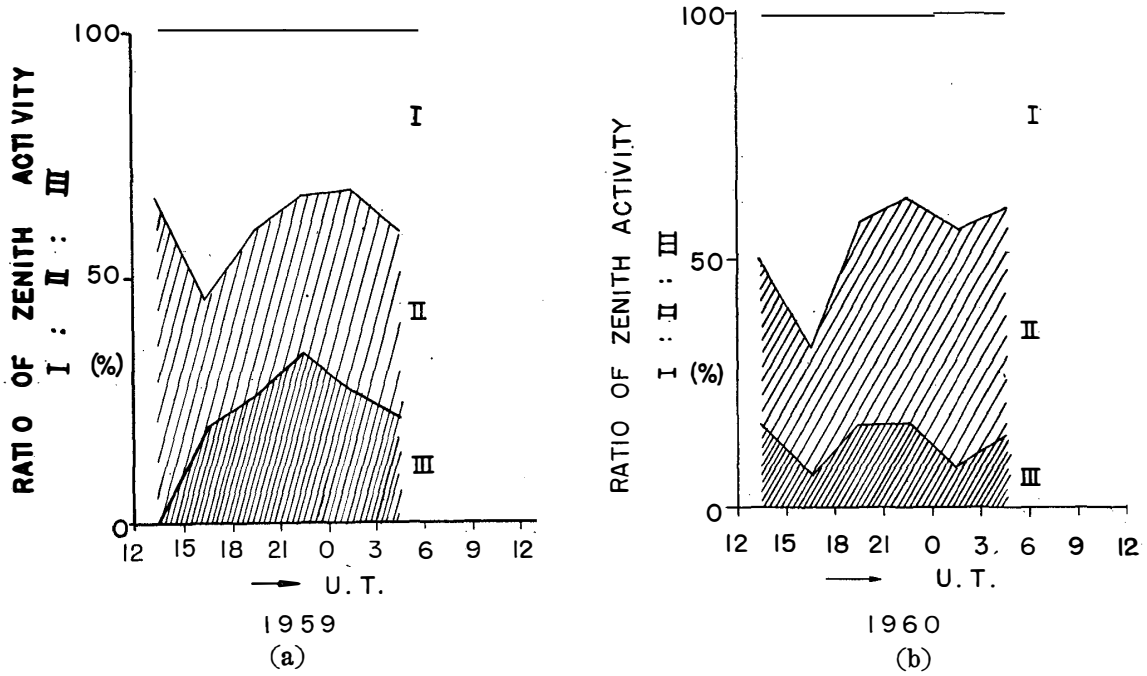

Fig. 3. Percentage of 3-hourly occurrence in three regions of N, Z and S. a) 1959, b) 1960.

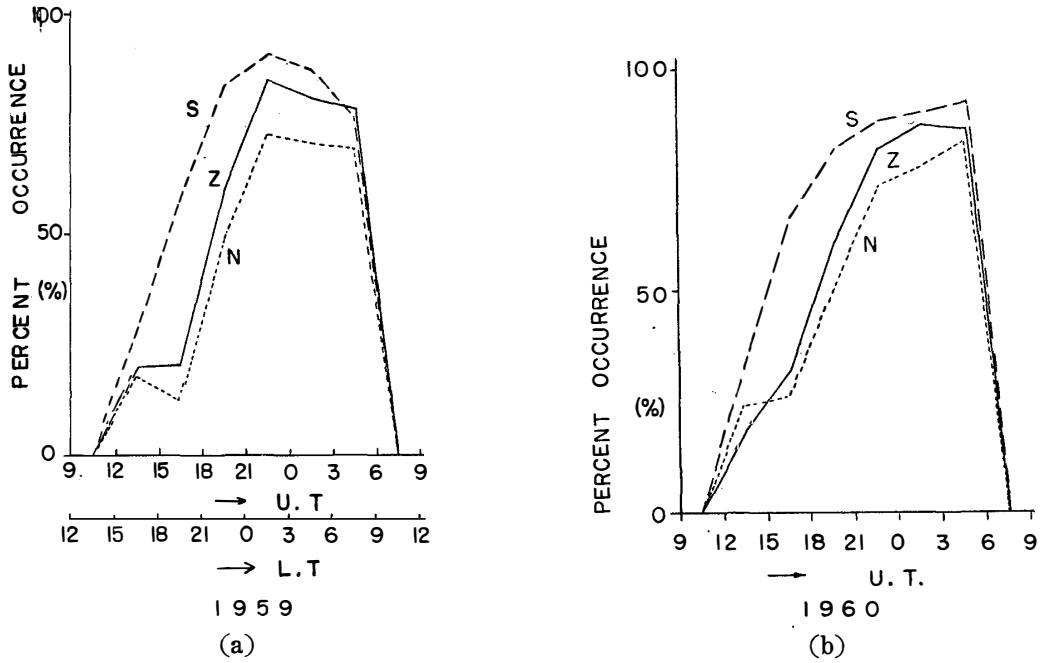

Fig. 4. 3-hourly mean ratio of zenith activity I : II : III. a) 1959, b) 1960.

Fig. 5 shows the correlation between auroral activity and K_s. The relation is almost linear and, comparing it with Table 1 in the previous paper, it is known that the absolute intensity of [OI] 5577Å is proportional to the geomagnetic change.

Fig. 6 shows the percentage of spatial occurrence in the case of $K_s \geq 5$ and $K_s \leq 4$. As may be expected, the larger the K_s value, the greater the occurrence frequency.

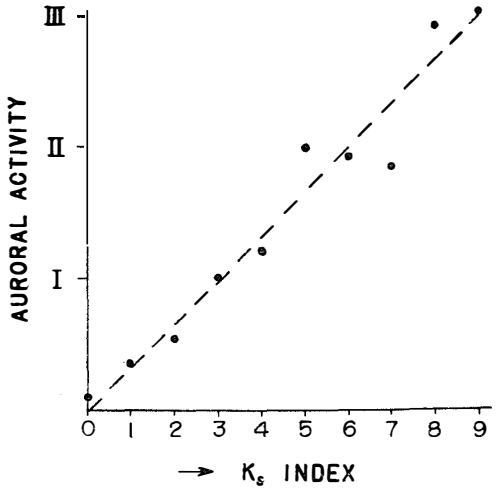

Fig. 5. Correlation between zenith activity of aurora and K_s (K-index at Syowa Station) in 1959.

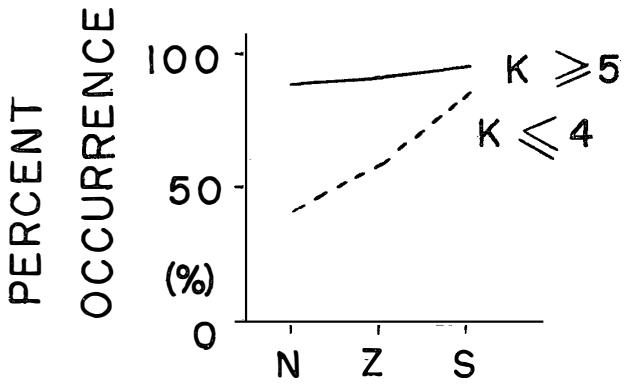

Fig. 6. Percentage of spatial occurrence in the case of $K_s \geq 5$ and $K_s \leq 4$ in 1959.

When the K_s value is large, aurora seems to appear at lower latitudes, whereas aurorae are limited to higher latitudes when K_s is small.

Fig. 7 shows the seasonal variation of percentage of occurrence. The variation is larger in the north region. In winter season, even when $K_s \geq 5$, the percentage is reduced with longer observation time.

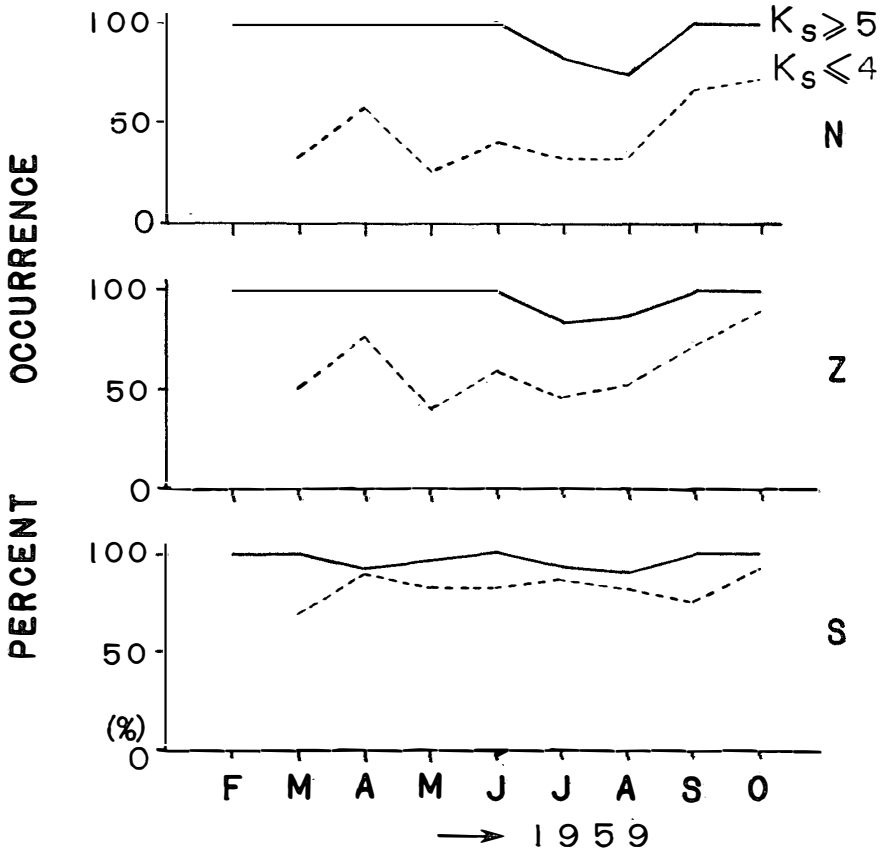

Fig. 7. Percentage of monthly occurrence in three regions of N, Z and S in the case of $K_s \geq 5$ and $K_s \leq 4$.

Fig. 8 shows the mean monthly zenith activity in the case of $K_s \geq 5$ and $K_s \leq 4$. Activity seems to be proportional to occurrence.

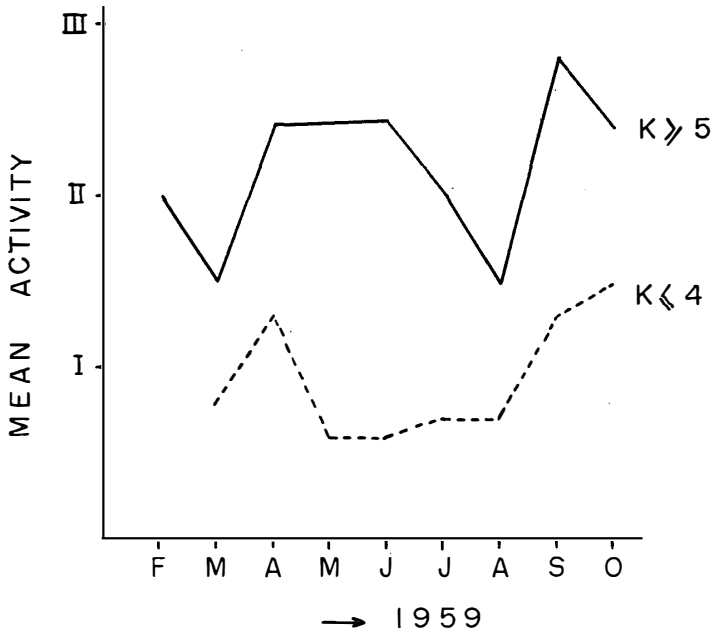

Fig. 8. Monthly mean value of zenith activity in the case of $K_s \geq 5$ and $K_s \leq 4$.

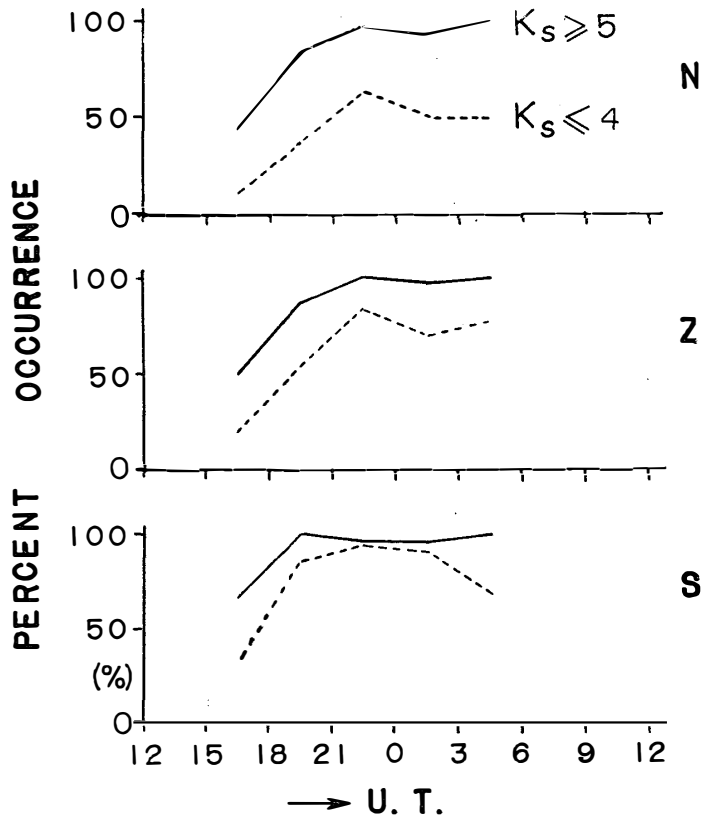

Fig. 9. Percentage of 3-hourly occurrence in three regions of N, Z and S in the case of $K_s \geq 5$ and $K_s \leq 4$.

In Fig. 9 daily variation of occurrence percentage is shown. In this example, aurora also appears after midnight, and when $K_s \geq 5$ aurora is inclined to appear in the whole sky, but when $K_s \leq 4$, aurora is apt to be restricted to the south region.

Fig. 10 shows the mean zenith activities that are high when $K_s \geq 5$, and low in the evening when $K_s \leq 4$.

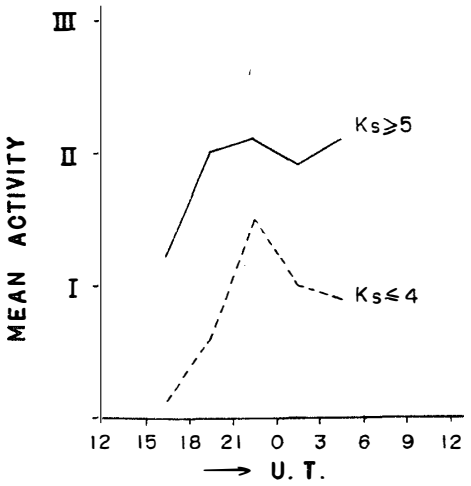

Fig. 10. 3-hourly mean value of zenith activity in the case of $K_s \geq 5$ and $K_s \leq 4$.

3. Discussions: As was reported previously[2], the auroral zone near Syowa Station seems to occur in the southern region, and in the time of magnetic storms it will spread out toward lower latitudes. Generally, the higher the occurrence frequency the stronger the auroral intensity.

Comparing auroral activity and K-index, the absolute intensity of [OI] 5577Å seems to be proportional to the absolute value of geomagnetic disturbance. But, its proportional coefficient does not coincide with OGUTI's value[3], our value being considerably lower than his. The relation in which auroral luminosity is proportional to the square of geomagnetic change when K_s's are small will have to be checked also.

In Fig. 9, when $K_s \geq 5$ the percentage of occurrence shows nearly constant value, but when $K_s \leq 4$ the value becomes much smaller in the evening, especially in the north. This tendency agrees with our consideration pertaining to time correlation between the incidented proton and the main auroral activity[4]. Fig. 10 also confirms it.

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References

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