Activity of the α Capricornid meteor shower in 1946

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Abstract. The existing data on the very broad and complex, but poorly known α Capricornid meteor shower are reviewed. New data on its activity are derived from the results of the extensive meteor observations, carried out at the Skalnaté Pleso Observatory in the first half of August 1946. Among over 3200 meteor records, only 54 α Capricornids are identified. The existence of a secondary shower maximum around the solar longitude of 137° is confirmed. After the application of the corrections for the zenith distance of the radiant, and for the effects of moonlight, twilight and partial cloudiness the maximum zenithal rate is estimated at 15 naked-eye meteors per hour.

Key words: meteor shower – hourly rate

1. Introduction

The α Capricornid meteor shower has been known from visual observations since the 19th century, but only photographic and radar observations have provided a more comprehensive picture of the shower. The shower is known as producing bright, slow meteors (Denning, 1899). Its maximum zenithal hourly rate is estimated at 6 to 14 meteors. There are indications that during the shower's activity 2 to 3 different maxima occur.

The shower was observed for the first time probably in 1871 when Konkoly-Thege recorded 6 meteors on July 28 and 29 at a radiant position of $\alpha = 305^{o}$ and $\delta = -4^{o}$ (Kronk, 1988). Denning and Weiss observed the shower at the end of the century (Denning, 1899), and visual observations made in New Zealand in 1927-34 were processed by McIntosh (1935).

More data about the shower were obtained by the analysis of double-station photographic records by Wright, Jacchia and Whipple (1956). They drew the conclusion that the shower consists of two streams, the first of which is active from July 16 to August 1, and the second from August 1 to 22. Kronk (1988) re-examined the photographic records of the shower obtained in the USA and USSR. He confirmed the existence of two streams, pointed out by Wright et al. (1956), and claimed the existence of a third stream. The individual streams can be characterized as follows:

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The first stream produces the main component of the α Capricornid shower. Its activity lasts from July 16 to August 29. Its maximum occurs on August 1 (l = 128.6°) with the mean apparent radiant at α = 306.7°, δ = −8.3°. The second stream corresponds with the second stream of Wright et al., and is active from August 8 to 21. Its maximum occurs on August 15 (l = 141.9°), with α = 322.4°, δ = -13.1°. The third stream is active from July 15 to August 1. Its maximum occurs on July 25 (l = 122.2°), with α = 302.7°, δ = -12.5°.

Radar observations of the shower have been conducted since 1960. From a series of observations made in 1961 - 65, the period of the shower activity was established as July 30 to September 11, with the maximum occurring on August 20 (l = 146.8° with α = 326.4°, δ = -11.9° (Sekanina, 1973). The series of observations made in 1968 and 1969 indicates that it is active from July 25 to September 9, and that its maximum occurs on August 9, with α = 314.8°, δ = -7.1° (Sekanina, 1976). These results show that the 1961-65 observations resemble the second stream mentioned above, and the 1968-69 observations the first stream, both corresponding to the two streams identified by Wright et al. (1956).

Processing of Australian observations made in 1979 indicates that the shower has three maxima: the first on July 22, the second on July 28, and the third on August 5 (Kronk, 1988).

In his list of meteor showers Cook (1973) gives the α Capricornid period of activity as July 15 to August 10, with a mean radiant position of α = 307°, δ = -10° at l = 127°.

The most recent results (Neslušan et al., 1993) indicate that the shower is active from July 15 to August 21, and that its mean radiant position is α = 317°, δ = -8° at l = 134°.

As can be seen from the individual results, the data display a considerable scatter. This may be due to the activity of other meteor showers at the time of the α Capricornids, as well as to the low-inclination orbit with better observing conditions in the Southern Hemisphere. A considerable spread of the individual radiants cannot be ruled out either.

The quality of the results also depends on the observing conditions which are very rarely perfect. The limiting factors are:

a) Twilight effects - variations in the sky's background brightness related to the Sun's position below the horizon (Slančíková, 1975).

b) Disturbing moonlight during the whole time when the Moon is above the horizon, with the intensity depending upon its phase and position. At small phases this effect can be neglected, since it coincides with the twilight. At the time of full moon its disturbance lasts throughout the night and reduces considerably the statistical weight of the data (Tousey and Koomen, 1953).

c) Partial cloudiness, which can also reduce the meteor rate and its weight (Guth, 1941).

Considering the limiting factors mentioned, the dependence of the observed rate on the zenith distance of the radiant, and small contribution to the sporadic background, the curve of hourly rates becomes rather indeterminate (Zvolánková, 1983).

2. Data analysis

Visual observations of the α Capricornid meteor shower made in 1946, as a part of the systematic program of visual observations of sporadic meteors at the Skalnaté Pleso Observatory between August 5 and 14, are analysed in this paper. All observations during which cloud coverage exceeded 30 %, as well as observations by less experienced observers, were excluded from the processing.

The database used contains more than 3200 meteor records, but only 54 of them were identified as α Capricornid suitable for processing. The total net observing time of the individual observers was 43.55 hours (see Table 1).

Table 1.

Observer	Abbr.	k_{1p}	N_{pc}	t_{pc}
Bečvář A.	T	1.20	16	691
Dzubák M.	M	1.19	2	42
Kresák Ľ.	K	1.03	18	621
Maleček B.	Mk	1.99	0	72
Mrkos A.	A	0.87	6	490
Pajdušáková Ľ.	L	1.00	12	697

Table 1 gives the names and designations of all observers, their personal coefficients in 1946 as determined by Štohl (1969), k_{1p}; the sum of all meteor records of the individual observers used in this study, N_{pc}; and their net observing time in minutes, t_{pc}.

The observed α Capricornids were divided into half-hour intervals. The number of α Capricornids, N_p, the net time of observation, t_p, and the average cloud coverage were determined for each interval and observer, p. The solar depression was determined for the centre of each interval during the twilight. These data together with the personal coefficients and the moon-phase coefficients, as determined by Zvolánková (1980), were used to calculate the hourly rates for the individual observers according to the formula

$$f_o = 60\tau k_M \sum_1^{\varepsilon} N_p \left[\sum_1^{\varepsilon} t_p/k_{op}k_{1p}\right]^{-1} \tag{1}$$

where f_o is the corrected hourly rate, N_p the number of meteors observed by observer p in the given interval, t_p his net observing time, k_{op} the cloud-cover coefficient according to Guth (1941), k_{1p} the personal coefficient, according to Štohl (1966), ε the number of observers who took part in the observation within the given interval, τ the twilight coefficient according to Slančíková (1975), and k_M the moon-phase coefficient according to Zvolánková (1980).

These corrections were used to calculate the hourly rates for all intervals. For the intercomparison of the individual hourly rates they had to be reduced to the radiant in the zenith. Cook's (1973) co-ordinates were used to compute the zenith distance of the radiant z_1, and for the sake of comparison also those by Neslušan et al. (1993) were used to compute an alternative value, z_2. Denoting the zenithal hourly rate per one observer by f_z and the reduction factor by $\cos^\gamma\ z_R$, we have

$$f_z = f_o / \cos^\gamma\ z_R \qquad (2)$$

Table 2.

No	Date	T	l_{1950}	ΣN_p	Σt_p	f_{z1}	f_{z2}	τ	k_M	Observers
1	46.8.5	22:45	132.94	1	120	1.6	1.6	1	1	TLMMk
2		23:15	132.96	6	99	10.6	10.8	1	1	TLMK
3		23:45	132.98	4	90	7.6	7.7	1	1	TLK
4	46.8.6	00:15	133.00	4	90	8.4	8.3	1	1	TLK
5		00:45	133.02	1	90	2.4	2.3	1	1	TLK
6		01:15	133.04	1	90	2.8	2.7	1.001	1	TLK
7	46.8.7	22:45	134.86	2	120	4.3	4.2	1	1.77	TLAK
8		23:15	134.88	2	120	2.5	2.4	1	1	TLAK
9		23:45	134.90	2	120	2.6	2.5	1	1	TLAK
10	46.8.8	00:15	134.92	3	120	4.4	4.1	1	1	TLAK
11		20:45	135.74	1	64	5.3	5.4	1	1.93	TLAK
12		22:15	135.80	1	107	3.2	3.1	1	1.93	TLAK
13	46.8.9	21:45	136.73	2	48	13.7	13.1	1	2.07	TLAK
14	46.8.10	21:15	137.67	1	112	3.0	2.9	1	2.19	TLAK
15		22:45	137.73	1	107	3.0	2.7	1	2.19	TLAK
16		23:45	137.77	4	101	14.9	13.0	1	2.19	TLAK
17	46.8.11	00:15	137.79	4	120	13.4	11.5	1	2.19	TLAK
18		01:15	137.83	1	120	4.3	3.5	1	2.19	TLAK
19		21:45	138.65	1	120	2.9	2.7	1	2.28	TLAK
20		22:45	138,69	3	106	8.9	8.0	1	2.28	TLAK
21		23:15	138.71	3	116	8.5	7.5	1	2.28	TLAK
22		23:45	138.73	1	80	4.5	3.9	1	2.28	TLAK
23	46.8.12	01:45	138.81	1	120	5.8	4.3	1.074	2.28	TLAK
24		21:15	139.59	3	120	8.8	8.0	1	2.32	TLAK
25	46.8.14	20:45	141.49	1	113	3.8	3.4	1	2.24	TLAMk

Table 2 gives the zenithal rates f_{z1} (calculated using Cook's data) and f_{z2} (calculated using the data of Neslušan et al.) for the individual intervals, adopting the exponent $\gamma = 1.47$ as determined by Zvolánková (1983). In addition to these hourly rates, the table contains the following data: the ordinal number, date, middle of the time interval T in UT, solar longitude l_{1950}, total number of meteor records $\Sigma\ N_p$ made during the given interval by all observers, total net observing time $\Sigma\ t_p$ of all observers for the given interval, twilight coefficient τ, moon-phase coefficient k_M, and the designations of the individual observers participating in the given time interval. The date is given only for the first interval of each day and applies until the next date given.

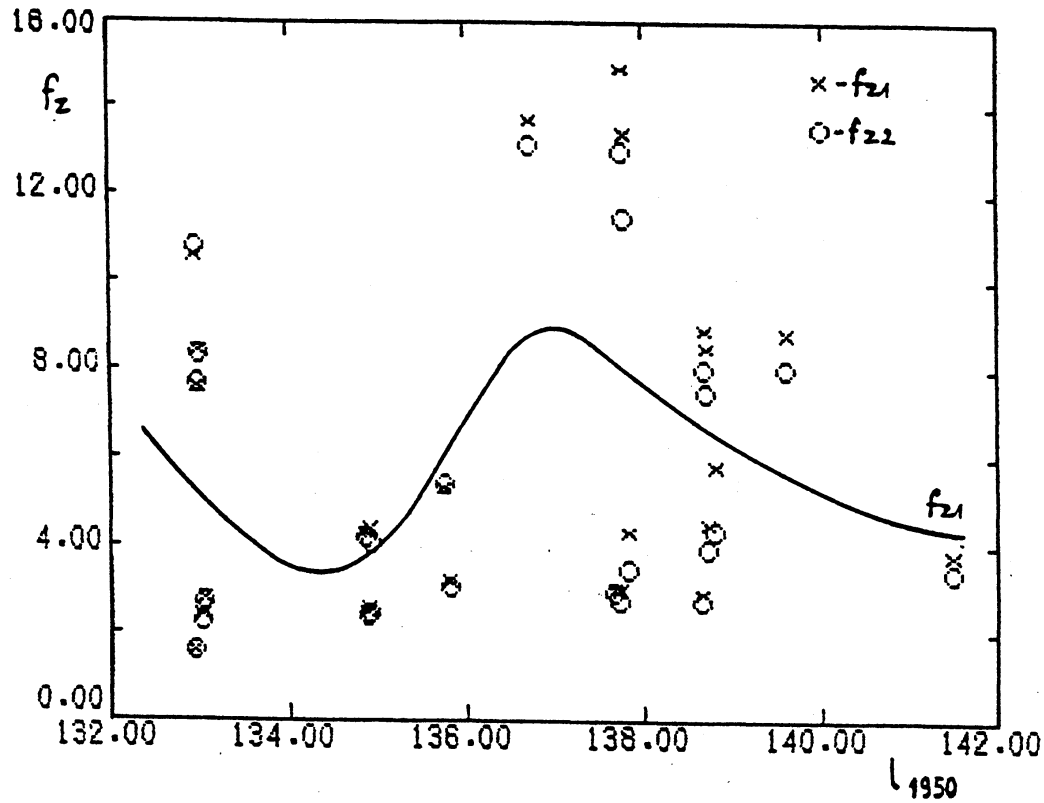

Figure 1. Zenithal hourly rates of the α Capricornid shower f_{z1} and f_{z2} for $\gamma = 1.47$ and solar longitudes $l_{1950} = 132^o$ to 142^o. The values of f_{z1} and f_{z2} are distinguished by different markings.

3. Conclusions

Due to the low position of the radiant above the horizon and lack of continuous observations, an overall curve of hourly rates cannot be determined from the data available. There were no observations before August 4 and, therefore, the first maximum of the shower's activity, which according to Cook (1973) occurs on July 30 at solar longitude 126°, could not be identified.

The results of this study indicate a second maximum on August 10 at solar longitude $l = 137^o$. This corresponds with the radar observations made in 1968-

69 (Sekanina, 1976) for which the maximum was determined on August 9, at solar longitude $l = 136.6^o$.

The maximum zenithal hourly rate for one observer, perfect observing conditions, and $\gamma = 1.47$ is $f_{z1} = 15$ or $f_{z2} = 13$, on August 10 at solar longitude $l = 137.77^o$.

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