The Summer Pegasids from IMO video data

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A July Pegasid and Upsilon Pegasid search in the IMO video database (1993–2004) is presented. The July Pegasids are typically assumed to be active from July 7–13, and the Upsilon Pegasids were reported to be active from approximately end July to end August. Neither minor meteor shower produces ZHRs higher than 3 at the dates of their maxima. The present investigation is based on nearly 23 000 non-Perseid video meteors of July and August. It does not show a clear indication of the July Pegasid radiant, according to day-to-day radiant distributions of 2001–2004. The August data of 1998–2004 show no evidence of an Upsilon Pegasid radiant either. Both showers may be inactive for the scope of video and visual means.

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1 Introduction

In the summer time, two meteor showers with the name of Pegasids can occasionally be found in the literature. First are the July Pegasids active only around July 7–13 (see e.g. Rendtel et al., 1995) and the second are the υ-Pegasids active from approximately July 23 to August 29 (e.g. Povenmire, 1998). Both showers have very fast meteors – V_∞ near 70 km/s for the July Pegasids and 50 km/s for the υ-Pegasids. Also both meteor showers lack in-depth research, and we cannot find many authors mentioning them at all. Do not confuse the July Pegasids with other Pegasid radiants mentioned in the literature (Cook, 1973; Neslušan, 2002; Svoreň et al. 2000) which are active in winter time and are not connected with the above mentioned meteor showers.

The July Pegasids are very fast meteors with V_∞ of 70 km/s, meaning that they have very distant aphelia. On the average, the ZHR of the July Pegasids is about 3. They have a maximum on July 11 ($\lambda_\odot = 108°$). Comet Bradfield (C/1979 Y1) is connected with them (cf. Rendtel et al., 1995). Recent research on the visual IMO database (Olech and Wiśniewski, 2002) confirmed their level of activity with ZHR $= 3.1 \pm 0.1$ on the day of the maximum.

The υ-Pegasids are mentioned only in the work of a single author, Harold Povenmire. First they were seen on August 8, 1975, as numerous meteors radiating from the square of Pegasus. Their activity is reported to vary in different years; the highest activity was seen on August 7–9, 1978, with a ZHR of approximately 20. In an average year, the ZHR of 3.5 is seen on the day of their maximum on August 8 ($\lambda_\odot = 134\overset{\circ}{.}5$). They are described as being fast, faint, yellow-white in color and lacking significant trails (Povenmire, 1998). Some fireballs were also associated with this shower, giving the approximate orbital elements of the stream and rejecting their hyperbolic nature which would be the key for their high velocity (Povenmire, 2001).

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2 The data set

This radiant investigation of the July Pegasid and υ-Pegasid meteor showers is based on individual meteors recorded by video systems (with and without image-intensifiers). All the observations from July and August in the years 1993–2004 placed on the IMO video network database are used (Molau, 2005a,b), with the exception of the Perseids in August which have been filtered out (those meteors which MetRec associated with the Perseid radiant).

The meteor data of the following observers is used (Molau, 2005a), ordered by the amount of observing hours contributed to the network :

> Sirko Molau, Jörg Strunk, Jürgen Rendtel, Orlando Benítez-Sanchez, Steve Quirk, Ilkka Yrjölä, Stane Slavec, Detlef Koschny, Mirko Nitschke, Stephen Evans, Javor Kac, Ulrich Sperberg, Stefan Ueberschaer, Robert McNaught, André Knöfel, Rosta Štork, Michael Gerding.

All the data were treated as single-station video observations in this analysis. The meteors were measured using the MetRec software by Molau (1999). The positional accuracy is of the order of few arc minutes. Time differences are known very precisely due to the constant rate of video frames, so the determination of the angular velocity should have an accuracy similar to that of the positions. During computation, the individual meteor positions are projected onto a common (average) line, and the velocity is computed as the weighted average over all pair-wise distances on this line. The length of a meteor part on a video frame with larger time difference gets a larger weight, so individual position errors should have little influence on the resulting velocity for meteors captured on a number of video frames (Molau, 2005b).

Figure 1 shows the distribution of meteor data per year and date. When looking at the sum of all observations day-to-day we reached the following conclusions:

- On average 200 meteors per day are captured until July 26; after that the average rises to 400 meteors per night (without Perseids).
- Since the year 2000 there has been complete day-to-day video coverage in August, since 2001 there has been also complete day-to-day video coverage in July, meaning that our research on July meteor showers is concentrated only on their activity in the last three years.

Table 1 – The observational statistics for the July–August period per year. The majority of Perseids in August have been filtered out already.

Year	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	Sum
N	37	44	0	288	737	162	1365	2718	4587	2571	5929	4507	22 945

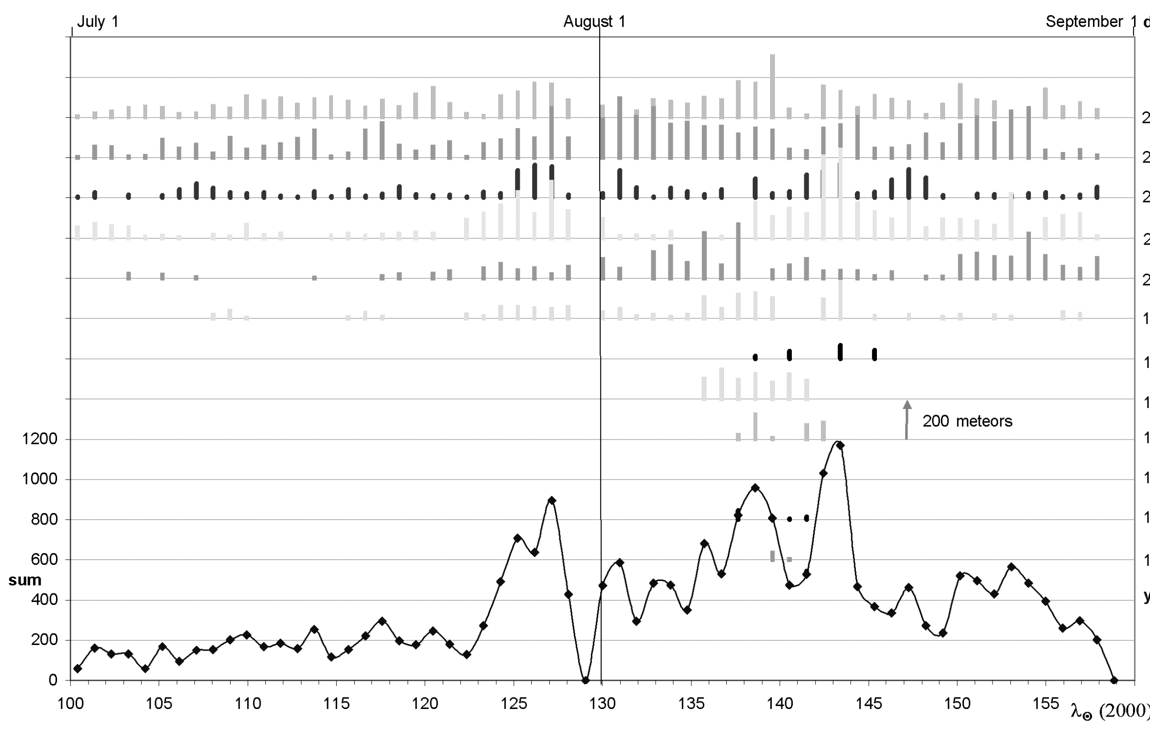

Figure 1 – Video observational statistics. The majority of Perseids in August have been filtered out from the 1993–2004 data (those already classified as Perseids by MetRec), the Perseids are left only in the July data as their contribution is negligible. The solar longitude is valid for equinox J2000.0, when 1 day is about 0°.96 on average in the July–August period. The number of captured meteors each night in each year is presented as a bar. The lowest graph shows the sum (N) of all the meteors captured in one night in the 1993–2004 period. In 1995, no meteors were captured in these two months.

Altogether this data sample contains 22 945 meteors. The number of meteors captured per year in this time interval is given in Table 1.

3 Method

The radiant analysis presented in this paper was made with the program Radiant (Arlt, 1992, 2001). All the radiant plots are the result of the 'Probability functions' of the Radiant software. 'Probability functions' are more powerful representations of the radiant than simple backward prolongation of the meteor. If path and velocity are precisely known, each individual meteor has one point (actually two on a great circle in general) which is its radiant. Positional errors and uncertainties in the angular velocity smear this point into an area of varying probability to be the radiant of that meteor. The values in this probability area form a sort of two-dimensional Gaussian function (Arlt, 1992, 2001, 2003). For more detailed information about the 'probability functions' see Arlt (2003).

Unless otherwise mentioned the parameters used to construct the 'probability functions' are the ones shown in Table 2.

Table 2 – Values for the positional distance d, angular velocity ω, and their standard deviations of video observations as used in Radiant (Arlt, 2003). Values in between the distances and velocities listed are obtained by linear interpolation.

d	0°	5°	15°	30°	50°	70°	
$\sigma(d)$	0.5°	0.9°	1.3°	1.5°	1.7°	1.8°	
ω	2.5	7.5	12.5	17.5	22.5	27.5	>30
$\sigma(\omega)$	1.0	1.5	1.9	2.3	2.6	2.9	3.0

4 July Pegasids

4.1 The velocity of the July Pegasids

In order to get a starting V_∞ for Radiant calculations, the value stated in Rendtel et al. (1995) of V_∞ = 70 km/s was used. We also calculated the value of V_∞ = 63 km/s from the average orbital elements of the comet C/1979 Y1 also given in Table 4 (Rendtel et al., 1995).

As the values for V_∞ differ significantly, we used a broad velocity band from 54 to 70 km/s (54, 58, 62, 66, and 70 km/s) for the Radiant calculations. Visual observers thus observe high-speed meteors in terms of angular velocity.

Table 3 – Supplementary table for Figure 2 – the July Pegasid radiant plots. N is the number of all meteors from that interval and n is the number of meteors actually contributing to the radiant plot.

Date	$\lambda_\odot$ [°]	v_∞ [km/s]	N	n
July 05	103	66	611	209
July 10	108	66	1186	300
July 15	113	66	1497	408
July 20	118	62	1303	301

Table 4 – Average orbital elements of Comet C/1979 Y1 – the probable parent body of the July Pegasids.

Ω	ω	i	e	q	a	P
°	°	°	°	AU	AU	years
103.22	257.58	148.60	0.988	0.545	44	291

4.2 The radiant plots

The plots were made for 5° solar longitude intervals from July 1 ($\lambda_\odot$ = 103°) to July 30 ($\lambda_\odot$ = 130°). In each 5° solar longitude interval there were on average 1100 meteors collected and 250 contributed to the Radiant plots covering approximately 40° × 40° with a pixel size of 0.4°. As no distinct radiant could be found on those plots, the calculations were repeated for a larger pixel size of 0.°6 and 0.°8. In all these cases, the radiant plots change a lot when changing the V_∞ and no distinct radiant can be followed in three successive V_∞ radiant plots (see Figure 2). In Figure 3, one can see the distribution of meteors in the interval July 1–22 around the probable radiant position, which is in the center of the Radiant plot. The meteors are distributed almost evenly within the inner square which represents the area of the Radiant plot shown in the following graphs. A larger portion of them are, however, on the northern side from the center of calculation. If we get a radiant it might be shifted a little to the north from its correct position, because of the slightly uneven meteor distribution.

On the radiant plots for the intervals July 10, July 15, and July 20, very weak structures slightly south of the predicted radiant can be found. If we compare them with other obvious 'radiant artifacts' seen elsewhere on the same Radiant plots, we consider all of the structures spurious. Moreover, those 'July Pegasid' radiants do not show any realistic radiant motion through the sky. At best they move from north to south and not parallel to the ecliptic.

The July Pegasid meteor shower activity cannot be confirmed from the video observations of the years 2001–2004 (see Figure 1).

5 The υ-Pegasids

5.1 The velocity of the υ-Pegasids

Povenmire (1998) suggested a velocity of $V_\infty = 52$ km/s for the υ-Pegasids. When using the orbital elements mentioned in Table 5 and the predicted radiant position, a lower value of V_∞ = 49 km/s can be derived. Given such a medium entry velocity, it has been argued that the υ-Pegasid radiant may be an artifact from the intersections of Aquarids typically moving towards high declinations for a northern observer, and the Perseids typically moving towards lower western parts of the sky as seen by an observer facing south.

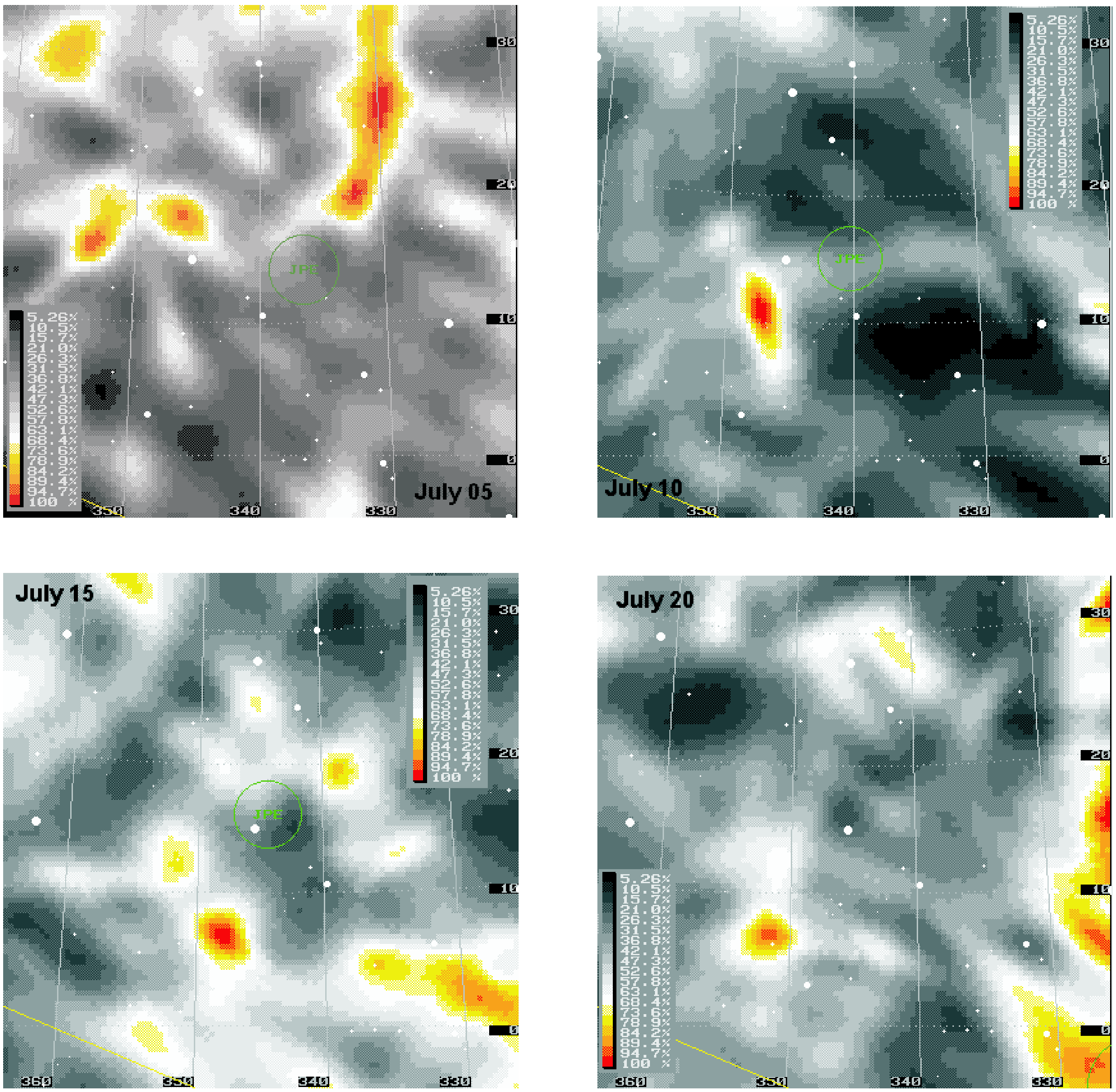

Figure 2 – The July Pegasid radiant plots – no radiant can be found. Top left: July 5; top right: July 10; bottom left: July 15; bottom right: July 20. See Table 4 for details.

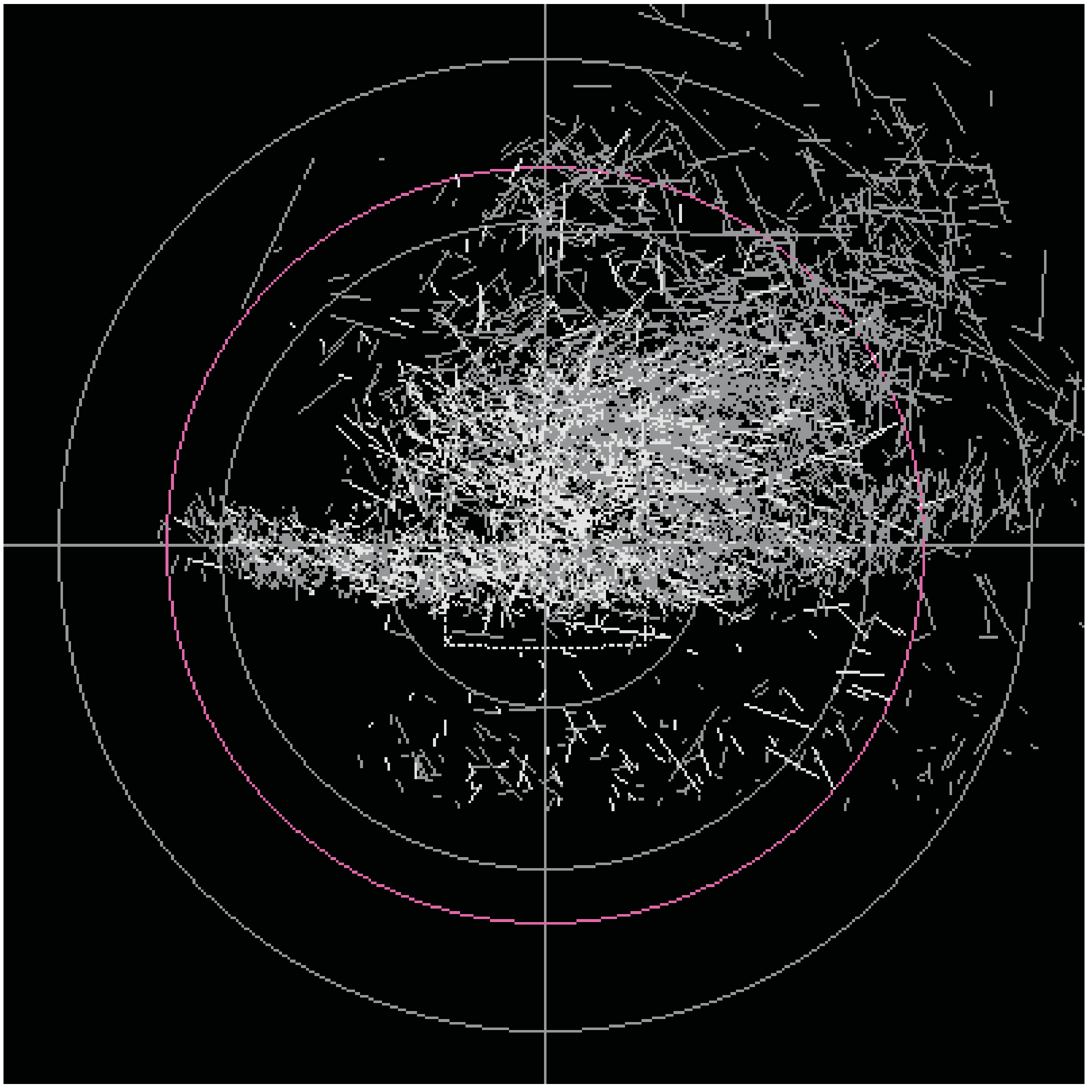

Figure 3 – The meteor distribution around the center of calculation at $\alpha = 340°$ and $\delta = 15°$, for the meteors of July 1–22.

Table 5 – The weighted mean orbital elements of the υ-Pegasid meteor shower (Povenmire, 2001).

Ω	ω	i	e	q
134.5°	303.4704°	79.33°	1.0	0.228 AU

5.2 The radiant plots

For the search for this radiant we again used 5° solar longitude intervals with velocities from 32 to 68 km/s (32, 38, 42, 48, 53, 58, 63 and 68 km/s) and 0.5° pixel size leading to a field of approximately 40° × 40°. The intervals around the possible date of the maximum from August 5 to August 20 were checked. No radiant could be found at the place suggested by visual records, which could be followed in two successive intervals. We therefore conclude that the υ-Pegasids were not active in the years from 1998 to 2004 (Figure 1). On the radiant plots made for the υ-Pegasid (see a sample in Figure 4) search, the radiant should emerge near the center of the distribution, where no distinct structure can actually be seen. In the southern part of the plot, an Aquarid source is found, probably representing the Northern δ-Aquarids.

6 Conclusion

In our previous paper (Triglav-Čekada and Arlt, 2005) we can see the example of the Taurid meteor showers, which are minor showers with a low ZHR of less than 5, and they are indeed found to be active in the radiant distributions. They do show well defined radiants which can be followed for a number of successive intervals. In the case of the July Pegasids, only very vague structures are found near the commonly reported position, but the existence of the shower *cannot be proven* with the analysis of video data of 2001–2004 when day-to-day observations in July are available.

The υ-Pegasids also *do not produce any radiant structure* which can be followed for at least two successive intervals. Since more video observations were gathered in August than in July, this statement was verified for day-to-day observations even for the seven-

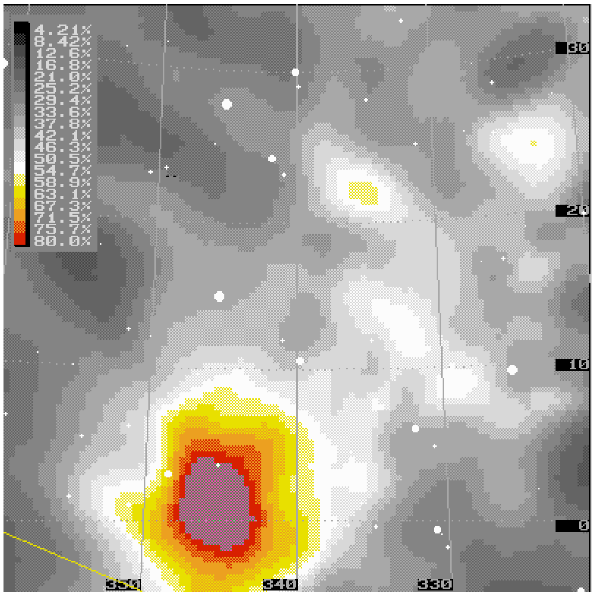

Figure 4 – The radiant plot made for 5° solar longitude interval with center on August 10 and $V_\infty = 48$ km/s, where υ-Pegasid radiant should be placed at the center of the display, but no υ-Pegasid radiant can be seen. Small structures seen on the display cannot be followed in other intervals. A total of 1010 meteors contributes to the radiant display, the majority forming the excluded Aquarid radiant source near the southern edge of radiant display.

year period of 1998–2004 which is longer than the July Pegasid sample.

Acknowledgments

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