Double-Station Meteor Observations in Ryazan, Russia

Andrey Murtazov, Alexander Efimov, Pavel Titov

46, Svobody St., Astronomical Observatory, Ryazan State University, Russia, 390000

a.murtazov@rsu.edu.ru

Optical meteor observation methods, observation equipment characteristics are described. Results of CCD-meteor observations of 2011-2012 at two stations are presented. The results of wide-angle bright Perseids observations make it possible to estimate the average meteoroid risk over the period of 2007-2012.

1. Introduction

The Ryazan State University astronomical observatory started meteor research within the scope of circumterrestrial space ecology at the beginning of century XXI (Murtazov, 2011):

- investigation of the circumterrestrial space mechanisms influence on the terrestrial biosphere;
- investigation of near-space processes being the circumterrestrial space ecology physical bases;
- monitoring of meteors, artificial space objects, and space debris in order to control the circumterrestrial space ecological state;
- implementation of the investigation results in higher school activities;
- organization of students' and schoolchildren's research activities in the field of space ecology.

In addition, observations of bright meteors are necessary to identify the natural risk in space

2. Observations and reduction

We use two points of observation for monitoring meteors: 1) the observational site of the university astronomical observatory in Ryazan (φ=54°38′N, λ=39°45′E, H≈125 m above sea level), and 2) the observational site in Sazhnevo, about 18 km from Ryazan with coordinates φ=54°28′N, λ=39°45′E, H≈200 m (Fig. 1).

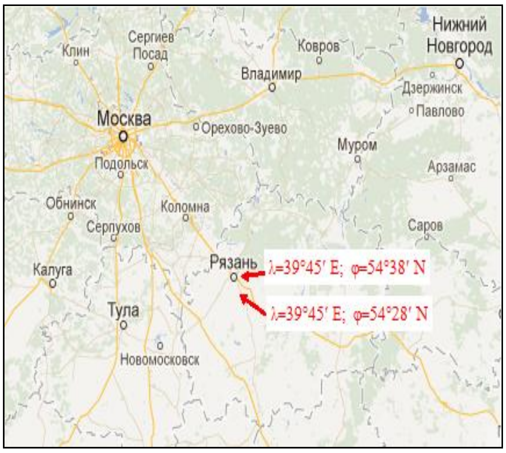

Figure 1. Observational poins of the Ryazan State University observatory.

Both of our station 2 observations were performed using a Wat-902H camera and a Computar T2314FICS lens with the effective field of view 140X100 arc degrees that was directed towards the local zenith. The sky control and meteor detection were provided using a Pinnacle Media Center EN or Contrast as a grabber and AMD Athlon(tm) 64X2 Dual Core processor 4200+, 2.21 GHz, 1 Gb RAM (Ryazan), and Inte(R) Core(TM)2 CPU processor, 1.83 GHz, 500 Mb RAM (Sazhnevo).

This equipment functioned in the mode assigned for registering bright meteors that present danger for space hardware operating in the circumterrestrial space (Murtazov et al., 2008).

Wat-902H camera and a Computar HG0808AFCS-HSP lens (FOV=34X45°) were used at both our stations in 2012.

For meteor detection we used free software: AM Cap - for making avi-files of all-sky images in continuous operation, and the SonotoCo free software - to capture meteor events.

Some parameters of the system.

Distortion of Computar lens according to our measurements is shown in Fig. 2, where: *D* is the true angular distance from the center of the frame, *R* — the same as measured with the stars. Thus, the cumulative distortion of wide-angle Computar lenses is up to 1-1.5 arc degrees at the distance of 90 degrees from the frame center.

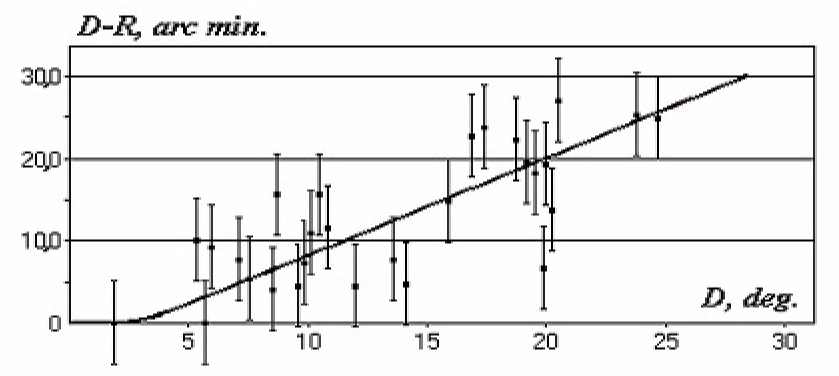

Figure 2. Distortion of Computar lens

The linearity of "magnitude-light flux" characteristic for CCD-systems is very high.

The relationship between comparison stars magnitude and their light flux obtained for them in every single frame is linear with the wide flux range of 10^4. This relationship for Watec-902H and Computar HG0808AFCS lens is shown in Fig. 3. Here *L* is the relative comparison stars brightness measured by means of IRIS aperture photometry (Buil, 2010). Different inclinations of straight lines are a result of different contrast frames measurements. Comparison star magnitudes are taken from HD (The Henry Draper Extension Charts: A catalogue of accurate positions, proper motions, magnitudes and spectral types of 86933 stars. Centre de Donnees astronomiques de Strasbourg Reference – III/182). The atmospheric extinction was obtained for every frame from avi-files containing meteors.

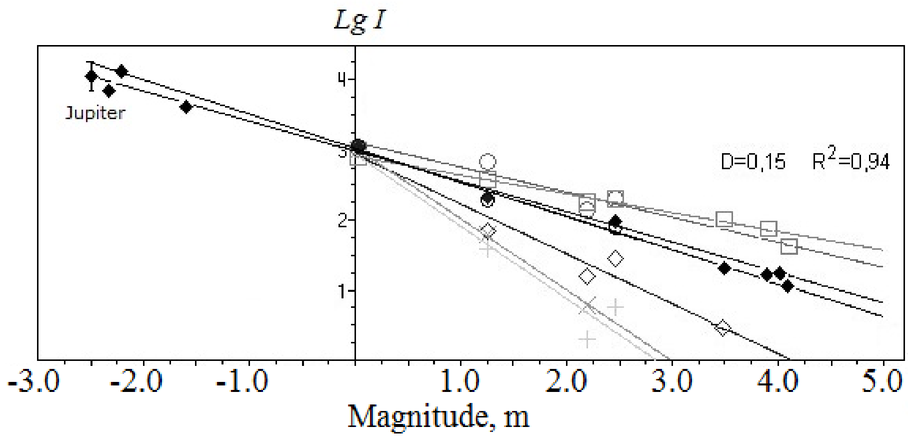

Figure 3. Linearity of "magnitude-light flux" relationship

3. Results

We continued our observations at the country station. As usual, our young astronomers took part in them. The 2011 results of wide-angle bright Perseids monitoring are shown in Fig. 4 as compared to IMO visual data.

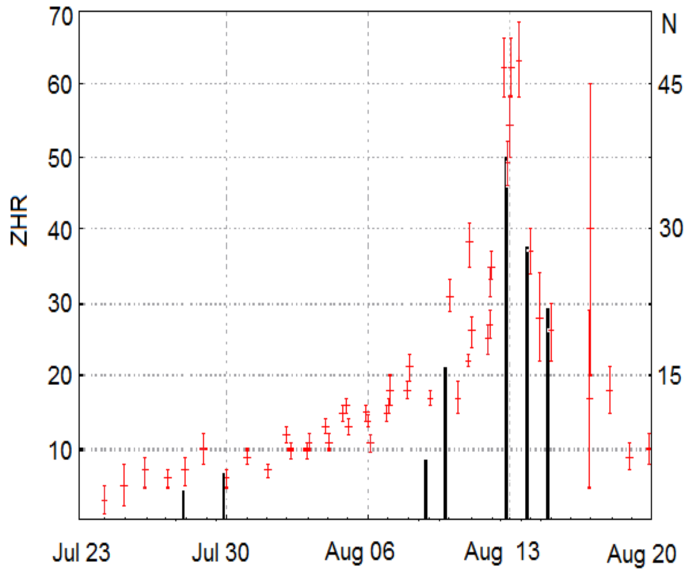

Figure 4. Number of 2011 bright Perseids as compared to IMO visual data.

Haze and mist prevented us from conducting good quality observation of Perseids-2012 in the period of their shower maximum with the wide-angle equipment. But we conducted both visual observations and also observations using our TV camera (though we did not manage to measure TV-meteor magnitudes). The results of these observations are shown in Fig. 5. The limiting magnitude of visual observations is 4^m, that of TV observations – brighter than 0^m.

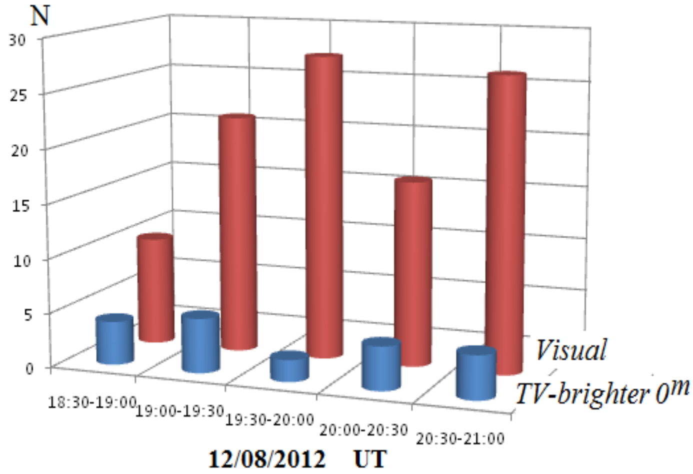

Figure 5. Comparison of Perseids-2012 visual and wide-angle TV observations.

Long-time observations of bright (and hazard) Perseids allow us to calculate the meteoroid risk in near-space.

Fig. 6 shows the average values of 2007-2012 bright meteor spatial density. The maximum of this distribution is close to the solar longitude about 140-141 arc degrees and practically coincides with the maximum of all IMO meteors.

The spatial density of meteoroid flux here defines the highest possible value of the meteoroid risk for space vehicles in near-space. So, these results give evidence of the fact that the predictable risk increased several times in the period of Perseids' main maximum.

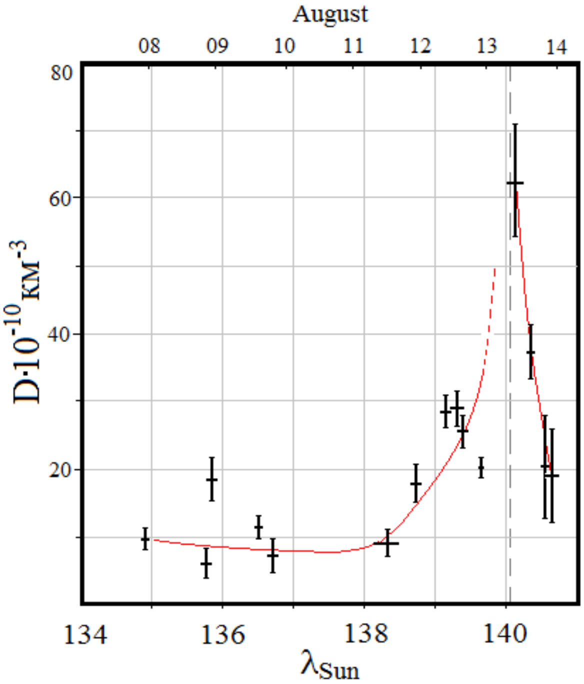

Figure 6. Average 2007-2012 bright Perseids maximum for φ=54°28′N, λ=39°45′E station. The dates above are for non-leap years

In 2011 we began meteor observations at the astronomical observatory. Wide-angle observations in the center of the city are impossible because of the bright street lighting. So we used the system of Wat-902H and Computar HG0808AFCS lens with FOV=34X45°.

This system was used for Draconids, Orionids-2011, and Perseids-2012 observations (Fig. 7-8).

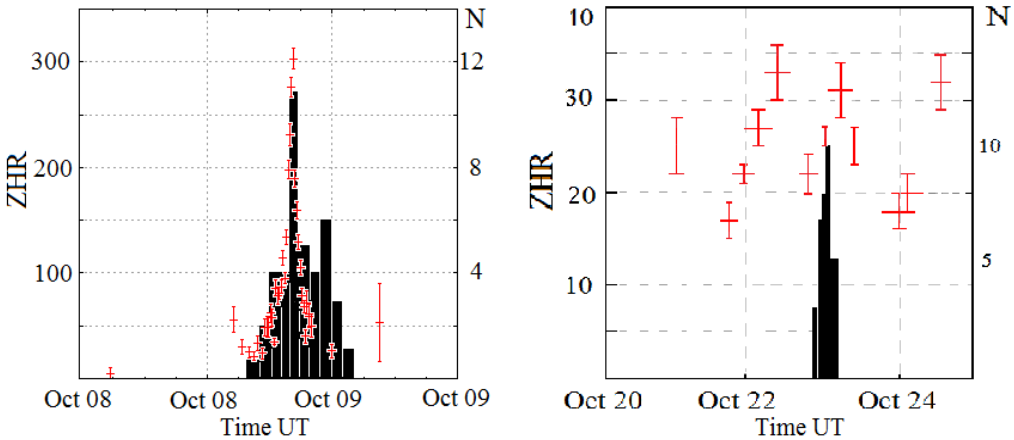

Figure 7. Results of Draconids and Orionids-2011 observations versus IMO data.

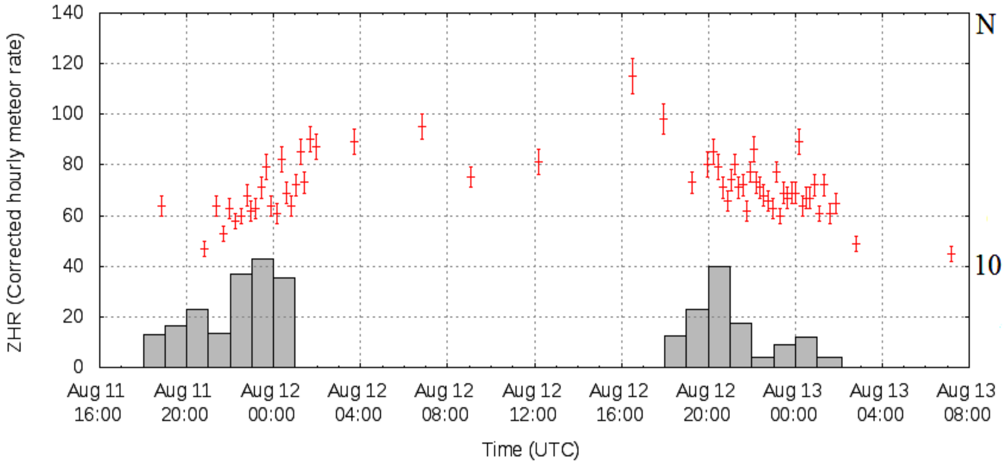

Figure 8. 2012 TV Perseids in Ryazan. FOV=34X45°. m_{Lim}=3.

In 2012 we attempted to make basic meteor observations from both of our sites using the system of Wat-902H camera and HG0808 AFCS-HSP lens (FOV=34X45°).

Fig. 9 shows the basic meteor from Perseids. The left picture is the result of adding 100 bmp-frames from avi-file (Sazhnevo), the right one – 100 frames captured and added by SonotoCo (Ryazan).

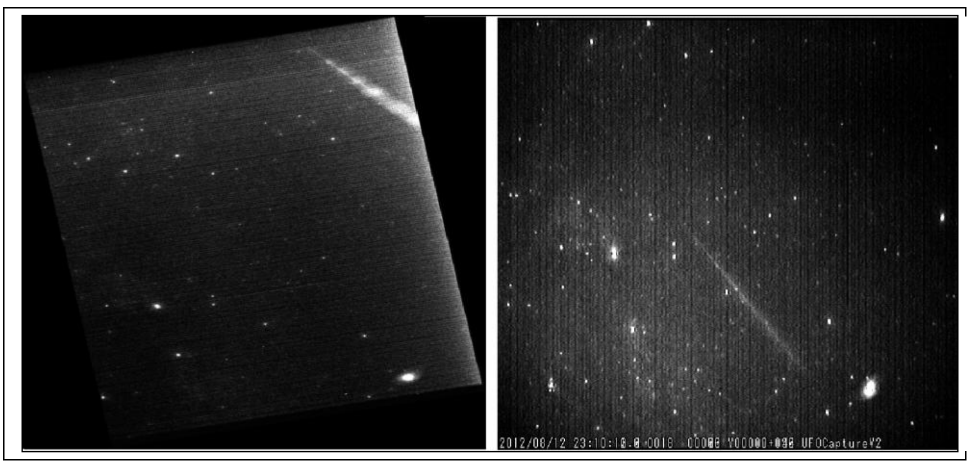

Figure 9. Basic meteor from Perseids

The total number of observations conducted in 2011-2012 are given in the table below.

Table 1

Total 2011-2012 results of meteor monitoring in Ryazan, Russia

Shower	Site	Date	FOV, arc deg.	Meteor m_{Lim}	N
South Δ-Aquariids (SDA)	Sazhnevo	2011, Jul, 30	140X100	+1	6
α-Capricornids (CAP)	Sazhnevo	2011, Jul, 30	140X100	+1	2
Perseids (PER)	Sazhnevo	2011, Aug, 9-13	140X100	+1	80
Draconids (DRA)	Ryazan	2011, Oct, 8	45X34	+4	36
Orionids (ORI)	Ryazan	2011, Oct, 23	45X34	+4	27
Perseids (PER)	Sazhnevo	2012, Aug, 11	140X100	+1	9
Perseids (PER)	Sazhnevo	2012, Aug, 12	45X34	+3	21
Perseids (PER)	Ryazan	2012, Aug, 11-14	45X34	+3	92

References

Buil C. (2010). “IRIS - Astronomical image processing software”. (http://www.astrosurf.com/buil/us/iris/iris.htm).

Murtazov A., Efimov A. V., and Kolosov D. (2008). “Bright Perseids in 2007”. *WGN, Journal of the IMO*, 36, pp. 77–78.

Murtazov A. (2011). “Arrangement of Integrated Meteor TV-Observations at the Ryazan State University Astronomical Observatory”. *Vestnik of Siberian aerospace university*, 6(39), pp. 109-113.