Results of the IMO Video Meteor Network – June 2016

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June convinced with perfect observing conditions. A quick look at the statistics shows only few gaps with a highlight on June 6/7, when 67 out of 75 cameras were active. Only in Slovenia and parts of Germany the weather was mediocre, otherwise most cameras enjoyed great conditions. In the end we counted fifty cameras with twenty or more observing nights and one camera (LIC1) which observed without any break at all.
With respect to the total effective observing time we fell only about 3% short of the result from 2015. On the other hand, it was for the first time that we recorded more than 20,000 meteors in June, which is an increase by 15% relative to the previously best result.

With respect to the meteor showers, June represent the "calm before the storm". The average hourly meteor rate has already increased by 50% relative to the annual low in March, but the nights are very short in the northern hemisphere and there is no ponderable meteor shower. You have to observe an average of ten hours in the small morning observing window to catch one Daytime Arietid, for example, and even then it could be a sporadic meteor that aligns only by chance with the shower radiant. In other words, only every other camera managed to record a single Daytime Arietid in this season.
The observing geometry for the June Bootids is much better, since the radiant is circumpolar in central Europe and lies close to the zenith at the begin of night. Hence, we have a large effective collection area for this shower and would be able to detect even lowest shower activity with a ZHR below 1 in our video data, but as in the years before the shower was not active in 2016.

So let's address once more the algorithms of video meteor observation. In the March report we presented, how the angular meteor velocity affects the meteor limiting magnitude of a camera. The only parameter of this model, which assumes that stars and meteors are radial-symmetric Gaussians, is the variance of the Gaussian distribution. This has to be estimated for every video camera from imagery.

Before we have a closer look at the algorithm to determine the variance, let's first consider a particular problem we encountered when developing the algorithm. Whenever we are calculating brightnesses, we obtain the pixel sum of an object (star, meteor). At first, the background brightness is determined at the location of the object, then all pixel belonging to the object are selected (those which are connected to one another and which are by a certain amount brighter than the background) and finally these pixel values are accumulated after subtracting the background. The background brightness is determined by aperture photometry. The average brightness of all pixels along a close circle around the objected is calculated, omitting particularly bright (e.g. nearby stars) and faint pixels (e.g. dust at the sensor).

Aperture photometry works fine for Mintron and Watec cameras which have a uniform background. However, image-intensified cameras often show a strong background brightness gradient, making up for several grey levels even within the small area around an object. That's not an issue for the calculation of the background brightness, because the values of all pixels around the objects are averaged. However, it may happen that the background pixels at the brighter edge of the object are beyond the threshold and thus counted as belonging to the object. The impact is small for photometry, but it hurts the algorithm to estimate the variance which will be presented below, since these pixels have a large distance from the object center and consequently a big weight.

Now the procedure is improved such that the local brightness gradient around the object is detected and accounted for. The simplest form is a linear gradient with constantly increasing brightness in one defined direction. Since we are looking at only a small area around the object, that model is sufficiently precise. If the brightness of the pixels along a circle around the object is plotted against their position angle relative to the object center, they will follow a sine function if a linear gradient is present. Now the task is to fit a sine function to the observed pixel values and determine the direction and strength of the gradient.

Figure 1 shows exemplarily the pixel values around a star from an image-intensified camera (figure 2, left) and a fitted sine curve with an amplitude of *A=5.2* and a phase angle of *φ=305°*.

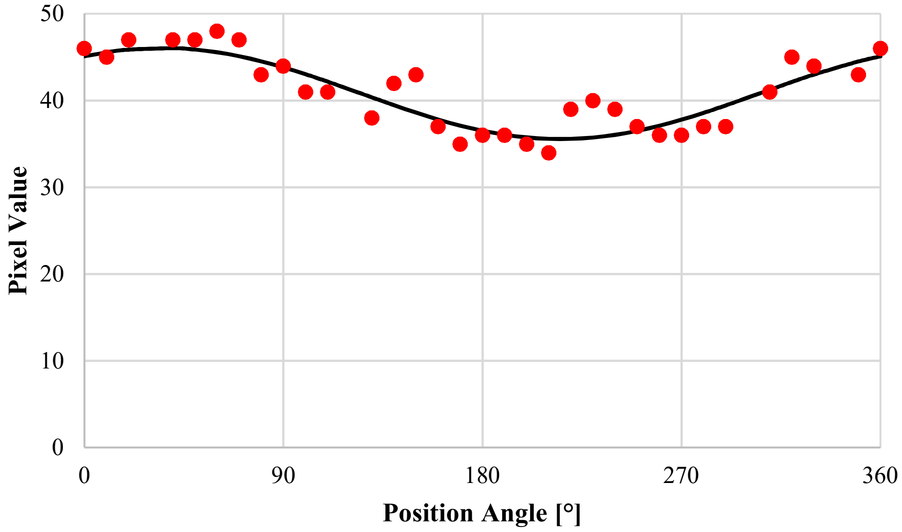

Figure 1: *Pixel values around a star in an image-intensified camera with brightness gradient (dots), and the corresponding sine function (line).*

Since the frequency of the sine function is well-known (the pixels originate from a circle around the object and thus cover exactly 360°), we can use a simplified presentation for the sine function:

$$1) \qquad h = A * \sin(x + \varphi) + O$$

Thereby *h* represents the pixel brightness, *A* the amplitude of the brightness gradient, *x* the position angle relative to the object center, *φ* the phase angle (which defines the direction of increasing brightness) and *O* the offset. *O* is simply the average pixel value – the only unknown factors are the searched values *A* and *φ*. A quick online search revealed that in this simplified case with known frequency there is no need for an iterative parameter estimation, but there exists a closed-form solution to determine the best parameters with least mean squared error. In order to do so, we represent equation 1 in a different form

$$2) \qquad h = a * \sin x + b * \cos x$$

whereby the searched values A and φ can be calculated as follows:

$$3) \qquad A = \sqrt{a^2 + b^2}$$

$$4) \qquad \varphi = \tan^{-1}\left(\frac{b}{a}\right)$$

In equation 2 we can determine a and b independently by linear regression. The corresponding equations 5 and 6 look complicated, but they can be implemented with just a few lines of code und require no expensive iterative optimization:

$$5) \qquad a = \frac{\sum_n(\cos x_n)^2 * \sum_n h_n sinx_n - \sum_n \sin x_n \cos x_n * \sum_n h_n \cos x_n}{\sum_n(\sin x_n)^2 * \sum_n(\cos \ _n)^2 - (\sum_n \sin x_n \cos x_n)^2}$$

$$6) \qquad b = \frac{\sum_n(\sin \ _n)^2 * \sum_n h_n \cos x_n - \sum_n \sin x_n \cos x_n * \sum_n h_n \sin x_n}{\sum_n(\sin x_n)^2 * \sum_n(\cos \ _n)^2 - (\sum_n \sin x_n \, co \ _n)^2}$$

Once the phase angle and amplitude of the brightness gradient are calculated for the object, the calculation of pixels that belong to the object is not anymore based on the average background brightness *O*, but rather on the local background brightness at the position of the pixel estimated by equation 1.

The result will be presented for two cameras. Figure 2 shows on the left side a recording from the image-intensified camera AVIS2 with a strong brightness gradient, and on the right side from an ordinary Mintron (MINCAM1) without brightness gradient.

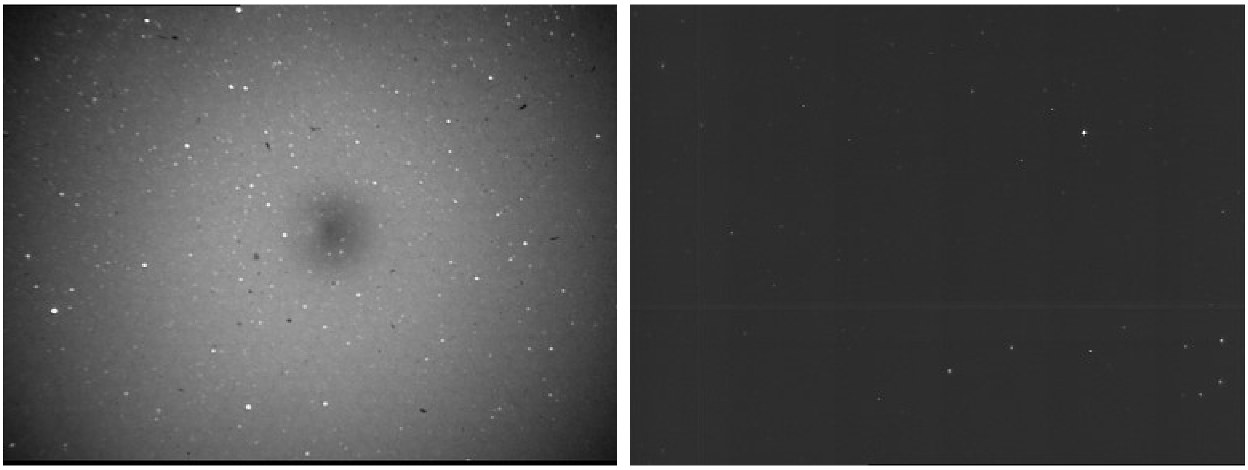

Figure 2: *Recordings of an image-intensified camera with brightness gradient (left) and of a Mintron camera without brightness gradient (right).*

In figure 3 we calculated the phase and amplitude of the brightness gradient for each pixel and presented the result as vector graphics. The direction of the vector represents the direction of increasing brightness and the length of the vector represents the amplitude. It can be seen that the background brightness of the image-intensified camera increases and decreases radial-symmetrically from the center, whereas there is not clear brightness gradient for the Mintron camera.

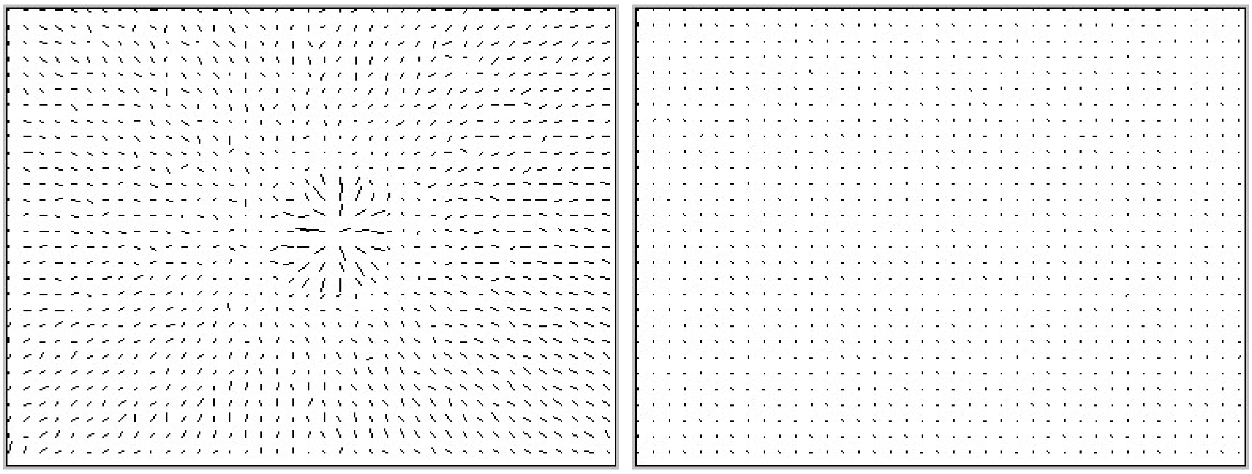

Figure 3: *Phase angle and amplitude of the brightness gradient in the recordings of figure 2. Each vector marks the direction and amplitude of the brightness increase.*

In figure 4 and 5, the phase angle and amplitude information is displayed independently. In case of the phase angle (figure 4, encoded with grey levels), the image-intensified camera shows the expected radial-symmetric image. For the Mintron camera we would expect random phase angles. In reality, there are faint vertical and horizontal stripes in the original image with result from interferences and which show up markedly in the phase plot.

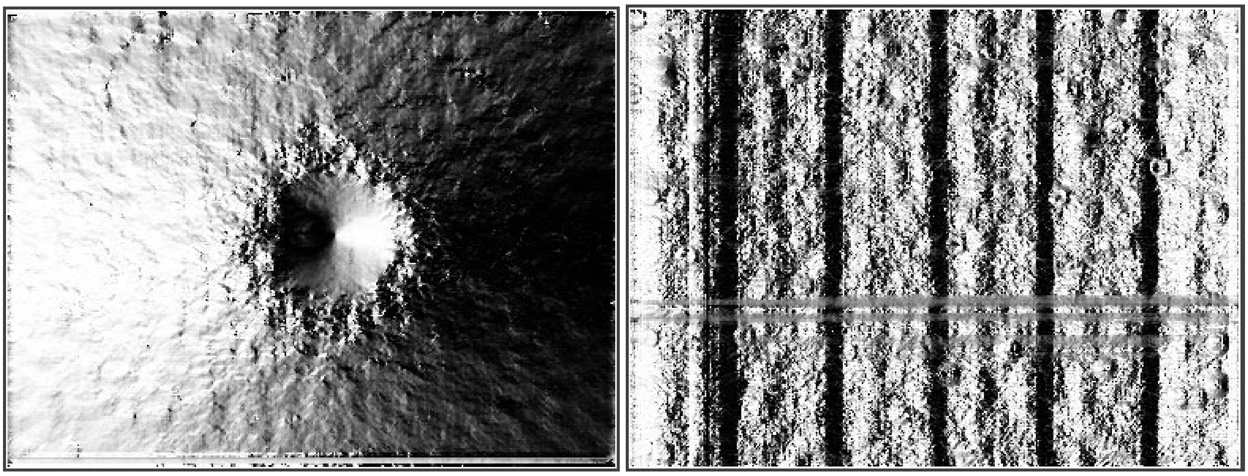

Figure 4: *Phase angle (coded in grey levels) of the brightness gradient for the recordings in figure 2.*

In case of the amplitude (figure 5) we see the largest gradient of the image-intensified camera directly at the center, whereas the stripes in the Mintron recoding are hardly visible. Some small rings are artifacts which result from the fact that bright stars cannot be removed completely by aperture photometry. At some point we simply have to define a threshold between a brightness increase caused by a strong gradient and by a nearby star.

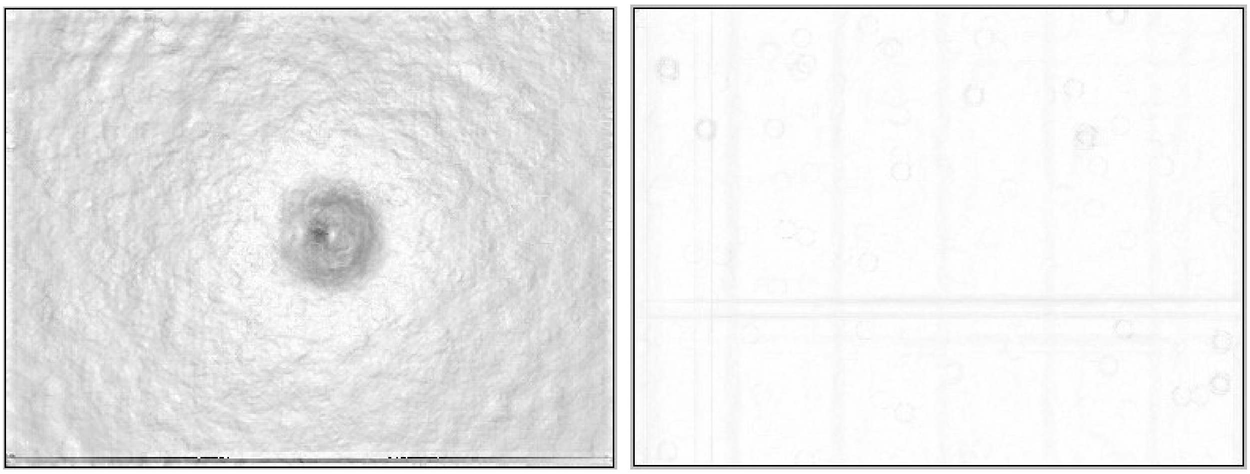

Figure 4: *Amplitude (coded in grey levels) of the brightness gradient for the recordings in figure 2.*

After we solved the problem of the brightness gradient, we can now care about the variance estimation of star and meteor images (point spread function). We will see that there is no closed form solution this time, so that we have to estimate the variance iteratively by a robust method of approximation.

In the general case, a two-dimensional Gaussian (also called bi-variate normal distribution) of pixel values $h_{x,y}$ can be expressed by seven parameters:

- x- and y-coordinate of the center: μ_x and μ_y.
- Offset O (background brightness) and amplitude A (maximum brightness) of the normal distribution.
- Variances σ_x and σ_y of the normal distribution in x- and y-direction, and the correlation coefficient ρ between the two axes.

7) $$h_{x,y} = \frac{A}{2\pi \;\, {}_x\sigma_y\sqrt{(1-\rho^2)}} * e^{\frac{-1}{2-2\rho^2}\left[\frac{(x-\mu_x)^2}{\sigma_x{}^2}+\frac{(y-\mu_y)^2}{\sigma_y{}^2}-\frac{2\rho(x-\mu_x)(y-\mu_y)}{\sigma_x\sigma_y}\right]} + O$$

An iterative approximation of seven free parameters would be extremely demanding, but luckily we can simplify the problem significantly:

- We assume a radial-symmetric Gaussian, i.e. $\sigma_x = \sigma_y = \sigma$ and $\rho = 0$.
- μ_x and μ_y are calculated as the mean *x*- and *y*-coordinates of all pixels belonging to the object, weighted by their brightness. At this step, the correction of the background brightness gradient described above is necessary to ensure that only pixels belonging to the object are included in the calculation.
- The background brightness O is determined by aperture photometry as described above.

Finally, we can remove the unknown amplitude A from the approximation scheme by summing up the pixel values cumulatively and normalizing the result in the end to unity.
In case of a radial-symmetric Gaussian, the *x*- and *y*-values are not relevant anymore – only the distance d of the pixel from the center counts:

8) $$d = \sqrt{(x - \mu_x)^2 + \left(y - \mu_y\right)^2}$$

This way we can reduce the approximation method to a single free parameter, namely the variance σ^2:

- The distance d to the center is calculated for all pixels that belong to the object.
- The pixels are sorted by their distance from the center.
- The pixel values (reduced by the background) are accumulated with increasing d, and in the end the values are divided by the total pixel sum to obtain a normalized distribution.

9) $$V_d = \frac{\sum_0^d (h_d - O)}{\sum_0^\infty (h_d - O)}$$

The cumulative distribution V_d represents, what percentage of the overall brightness of an object is found up to distance d from the center. The distribution has a characteristic form that only depends on the variance σ^2. Objects with small variance will concentrate most of the light near the center, whereas in case of larger variance also pixels farther away contribute significantly to the overall brightness.

In order to determine the variance of a star, we first calculate the brightness distribution. Then we calculate iteratively the expected distribution V_d for different variances σ^2 and finally select the value with smallest difference between observed and expected distribution (least squared error).

For a one-dimensional normal distribution, the cumulative distribution corresponds the Gaussian error function *erf(x)*. For bi-variate normal distributions, however, there is no closed form solution for the distribution V_d. For this reason, we applied the same simulation that was used in March to determine the limiting magnitude loss depending on the meteor angular velocity. The computer calculated for different variances σ^2 a high resolution two-dimensional Gaussian and simulated the mapping to a CCD chip of lower resolution. From the CCD image we obtained the cumulative distribution function V_d as described above, and then we searched empirically for an equation that would approximate the distribution function best. Not surprisingly, the error function *erf(x)* plays a central role in the resulting equation:

10) $$V_d = erf\left(\frac{2d}{\pi\sqrt{\sigma^2 + 0.09}}\right)^2$$

Figure 5 shows the cumulative distributions V_d for different variances σ^2 obtained by the computer model, and the approximation by equation 10 (black dashed lines). The correction term of 0.09 is already known from the March analysis. Also there we had to increase the variance by a constant factor of 0.09, because CCD pixels are not punctiform and have an integrative effect. Most likely the same explanation accounts for the offset here.

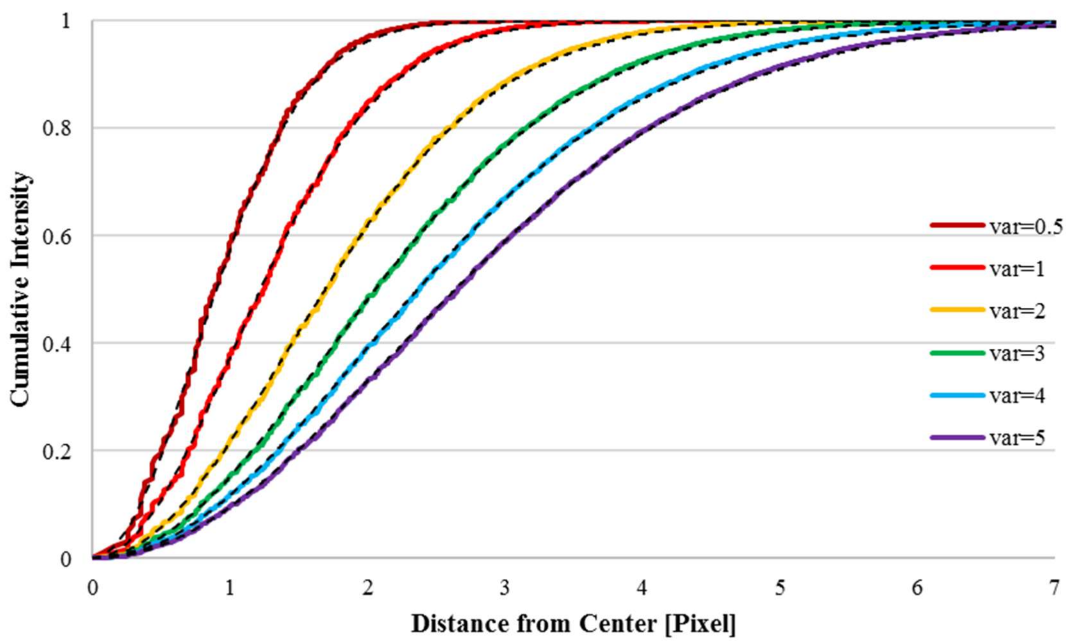

Figure 6: *Cumulative distribution function of a two-dimension Gaussian calculated by computer simulation (solid colored lines) and the corresponding approximations by equation 10 (dashed black lines).*

Now we still have to solve the practical problem, that in case of real video footage the stars consist typically of only a few pixels such that the cumulative distribution function relies on only a few support points. We could calculate the variance independently for each star because it may vary within the field of view (e.g. a larger variance near the edges caused by vignetting), but we want to work only with one variance value per camera. Ideally we should combine the measurements of all bright stars in the field of view into a single cumulative distribution to get a reliable estimate for the variance.

A simulation with different Gaussians having the same variance but different amplitude confirmed, that we may indeed combine different objects. For this purpose we do not calculate the distribution V_d for each star independently, but we combine all pixels from all stars. For each pixel we calculate the distance d to the center of the corresponding star, sort the pixels by increasing distance from the center, calculate the cumulative distribution over all pixels and normalize the distribution by dividing each value by the total pixel sum. For the resulting distribution we calculate the best-fitting variance by the approximation method described above.

So far for the theory. Which variances we obtain practically for different IMO network cameras and which influence that has on the transformation from stellar to meteor limiting magnitude will be shown soon.

1. Observers

Code	Name	Place	Camera	FOV [°²]	St.LM [mag]	Eff.CA [km²]	Nights	Time [h]	Meteors
ARLRA	Arlt	Ludwigsfelde/DE	LUDWIG2 (0.8/8)	1475	6.2	3779	26	89.3	431
BERER	Berkó	Ludanyhalaszi/HU	HULUD1 (0.8/3.8)	5542	4.8	3847	8	40.6	168
BOMMA	Bombardini	Faenza/IT	MARIO (1.2/4.0)	5794	3.3	739	27	122.2	378
BREMA	Breukers	Hengelo/NL	MBB3 (0.75/6)	2399	4.2	699	16	49.1	76
BRIBE	Klemt	Herne/DE	HERMINE (0.8/6)	2374	4.2	678	18	57.6	117
		Berg. Gladbach/DE	KLEMOI (0.8/6)	2286	4.6	1080	19	48.3	96
CASFL	Castellani	Monte Baldo/IT	BMH1 (0.8/6)	2350	5.0	1611	22	92.3	222
			BMH2 (1.5/4.5)*	4243	3.0	371	20	74.4	131
CRIST	Crivello	Valbrevenna/IT	BILBO (0.8/3.8)	5458	4.2	1772	25	108.3	318
			C3P8 (0.8/3.8)	5455	4.2	1586	22	91.2	232
			STG38 (0.8/3.8)	5614	4.4	2007	24	109.6	541
DONJE	Donati	Faenza/IT	JENNI (1.2/4)	5886	3.9	1222	25	139.1	452
ELTMA	Eltri	Venezia/IT	MET38 (0.8/3.8)	5631	4.3	2151	18	79.7	163
FORKE	Förster	Carlsfeld/DE	AKM3 (0.75/6)	2375	5.1	2154	16	60.1	201
GONRU	Goncalves	Tomar/PT	TEMPLAR1 (0.8/6)	2179	5.3	1842	29	166.1	553
			TEMPLAR2 (0.8/6)	2080	5.0	1508	27	157.4	387
			TEMPLAR3 (0.8/8)	1438	4.3	571	26	143.5	129
			TEMPLAR4 (0.8/3.8)	4475	3.0	442	26	155.3	399
			TEMPLAR5 (0.75/6)	2312	5.0	2259	28	146.4	353
GOVMI	Govedic	Sredisce ob Dr./SI	ORION2 (0.8/8)	1447	5.5	1841	24	101.5	218
			ORION3 (0.95/5)	2665	4.9	2069	27	95.6	147
			ORION4 (0.95/5)	2662	4.3	1043	25	87.6	148
HERCA	Hergenrother	Tucson/US	SALSA3 (0.8/3.8)	2336	4.1	544	24	166.4	276
IGAAN	Igaz	Budapest/HU	HUPOL (1.2/4)	3790	3.3	475	14	67.5	35
JONKA	Jonas	Budapest/HU	HUSOR (0.95/4)	2286	3.9	445	21	96.3	114
			HUSOR2 (0.95/3.5)	2465	3.9	715	23	106.3	134
KACJA	Kac	Kamnik/SI	CVETKA (0.8/3.8)	4914	4.3	1842	15	74.5	293
		Ljubljana/SI	ORION1 (0.8/8)	1399	3.8	268	19	78.3	216
		Kamnik/SI	REZIKA (0.8/6)	2270	4.4	840	15	77.8	400
			STEFKA (0.8/3.8)	5471	2.8	379	12	66.1	148
KOSDE	Koschny	Izana Obs./ES	ICC7 (0.85/25)*	714	5.9	1464	23	164.5	1341
		La Palma / ES	ICC9 (0.85/25)*	683	6.7	2951	26	160.2	1574
		Izana Obs./ES	LIC1(2.8/50)*	2255	6.2	5670	30	231.3	2012
		La Palma / ES	LIC2 (3.2/50)*	2199	6.5	7512	28	200.8	1730
LOJTO	Łojek	Grabniak/PL	PAV57 (1.0/5)	1631	3.5	269	18	79.7	199
LOPAL	Lopes	Lisboa/PT	NASO1 (0.75/6)	2377	3.8	506	20	115.7	59
MACMA	Maciejewski	Chelm/PL	PAV35 (0.8/3.8)	5495	4.0	1584	27	103.3	346
			PAV36 (0.8/3.8)*	5668	4.0	1573	25	98.5	273
			PAV43 (0.75/4.5)*	3132	3.1	319	24	94.0	131
			PAV60 (0.75/4.5)	2250	3.1	281	22	89.0	273
MARGR	Maravelias	Lofoupoli/GR	LOOMECON (0.8/12)	738	6.3	2698	10	36.3	40
MARRU	Marques	Lisbon/PT	CAB1 (0.8/3.8)	5291	3.1	467	27	179.7	364
			RAN1 (1.4/4.5)	4405	4.0	1241	27	148.4	244
MASMI	Maslov	Novosimbirsk/RU	NOWATEC (0.8/3.8)	5574	3.6	773	17	25.6	70
MOLSI	Molau	Seysdorf/DE	AVIS2 (1.4/50)*	1230	6.9	6152	20	38.1	176
			ESCIMO2 (0.85/25)	155	8.1	3415	20	73.0	127
			MINCAM1 (0.8/8)	1477	4.9	1084	17	55.9	159
		Ketzür/DE	REMO1 (0.8/8)	1467	6.5	5491	25	90.5	549
			REMO2 (0.8/8)	1478	6.4	4778	24	91.6	397
			REMO3 (0.8/8)	1420	5.6	1967	3	5.7	20
			REMO4 (0.8/8)	1478	6.5	5358	25	92.2	389
MORJO	Morvai	Fülöpszallas/HU	HUFUL (1.4/5)	2522	3.5	532	25	118.2	113
MOSFA	Moschini	Rovereto/IT	ROVER (1.4/4.5)	3896	4.2	1292	17	10.4	48
OTTMI	Otte	Pearl City/US	ORIE1 (1.4/5.7)	3837	3.8	460	27	128.6	194
PERZS	Perkó	Becsehely/HU	HUBEC (0.8/3.8)*	5498	2.9	460	23	98.5	256
ROTEC	Rothenberg	Berlin/DE	ARMEFA (0.8/6)	2366	4.5	911	20	36.2	86
SARAN	Saraiva	Carnaxide/PT	RO1 (0.75/6)	2362	3.7	381	23	101.8	145
			RO2 (0.75/6)	2381	3.8	459	20	117.9	194
			RO3 (0.8/12)	710	5.2	619	21	123.6	316
			SOFIA (0.8/12)	738	5.3	907	18	92.1	103
SCALE	Scarpa	Alberoni/IT	LEO (1.2/4.5)*	4152	4.5	2052	20	85.8	74
SCHHA	Schremmer	Niederkrüchten/DE	DORAEMON (0.8/3.8)	4900	3.0	409	17	42.5	83
SLAST	Slavec	Ljubljana/SI	KAYAK1 (1.8/28)	563	6.2	1294	19	82.5	217
			KAYAK2 (0.8/12)	741	5.5	920	17	73.3	116
STOEN	Stomeo	Scorze/IT	MIN38 (0.8/3.8)	5566	4.8	3270	25	80.1	357
			NOA38 (0.8/3.8)	5609	4.2	1911	24	83.9	281
			SCO38 (0.8/3.8)	5598	4.8	3306	27	84.8	401
STRJO	Strunk	Herford/DE	MINCAM2 (0.8/6)	2354	5.4	2751	18	55.8	172
			MINCAM3 (0.8/6)	2338	5.5	3590	17	43.5	110
			MINCAM4 (1.0/2.6)	9791	2.7	552	14	45.5	45
			MINCAM5 (0.8/6)	2349	5.0	1896	17	45.6	56
			MINCAM6 (0.8/6)	2395	5.1	2178	20	48.5	96
TEPIS	Tepliczky	Agostyan/HU	HUAGO (0.75/4.5)	2427	4.4	1036	21	103.8	115
			HUMOB (0.8/6)	2388	4.8	1607	25	106.4	238
TRIMI	Triglav	Velenje/SI	SRAKA (0.8/6)*	2222	4.0	546	20	35.1	84
Sum							30	6966.8	21849

* active field of view smaller than video frame

2. Observing Times (h)

June	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15
ARLRA	3.0	0.7	4.2	4.4	4.3	4.1	4.1	3.8	3.9	4.0	3.7	-	-	2.8	3.7
BERER	-	-	-	-	-	-	5.1	4.7	-	-	-	-	-	-	-
BOMMA	-	1.7	5.2	1.1	2.5	6.8	6.5	-	-	4.1	4.8	4.3	2.6	5.0	0.6
BREMA	1.8	-	4.4	4.8	2.6	4.5	0.3	-	4.2	-	4.2	-	-	2.1	-
BRIBE	-	-	3.7	4.7	4.9	4.8	4.7	3.3	4.0	-	-	-	-	1.7	3.4
	-	-	2.5	0.9	3.3	3.2	2.5	3.6	4.7	-	-	-	-	1.5	4.2
CASFL	-	-	2.3	5.0	-	6.4	4.4	-	4.7	-	5.7	3.3	-	0.4	-
	-	-	1.4	3.2	0.2	5.3	2.6	-	2.2	-	4.7	2.0	-	-	-
CRIST	5.7	-	-	2.2	3.0	5.4	5.1	1.4	4.5	3.9	-	4.4	1.5	2.2	-
	4.7	-	-	-	2.8	6.1	6.1	-	3.9	3.0	-	4.3	0.6	1.5	-
	5.9	-	-	2.1	1.5	6.2	4.8	1.6	5.0	4.3	-	5.2	2.3	3.3	-
DONJE	0.3	4.1	6.8	-	4.4	6.7	6.9	-	-	6.0	5.2	5.2	5.1	6.4	-
ELTMA	-	-	-	-	4.3	6.5	5.9	-	-	4.3	5.1	-	0.8	-	-
FORKE	-	-	-	-	4.8	5.2	5.0	-	4.6	3.5	-	-	-	-	5.0
GONRU	7.3	6.0	4.6	5.9	1.1	7.3	7.2	7.3	3.8	7.0	5.8	1.0	7.2	6.5	6.0
	7.5	6.1	4.9	5.6	1.2	-	7.4	7.4	3.6	7.3	5.8	-	7.3	5.8	5.9
	7.3	3.9	-	4.8	0.6	6.8	7.1	7.2	2.8	6.1	4.5	0.5	7.0	4.0	5.6
	7.5	3.7	3.4	4.9	-	7.4	7.4	7.3	3.3	7.0	5.0	-	6.9	6.1	4.9
	7.3	5.0	1.9	5.0	0.3	7.0	7.2	7.2	3.2	6.1	3.8	0.7	7.0	3.9	5.8
GOVMI	5.2	3.7	6.0	-	1.6	5.1	5.8	1.5	-	5.8	-	-	1.4	1.6	5.8
	3.7	3.6	5.7	2.6	1.0	2.7	5.8	0.6	-	5.8	0.3	0.2	1.4	1.0	3.8
	2.9	3.3	4.9	2.8	1.2	1.4	4.9	0.2	-	5.8	0.3	-	1.4	1.1	4.5
HERCA	3.7	8.5	8.5	8.5	8.5	8.5	8.3	8.5	8.0	2.3	8.1	8.1	8.4	8.4	7.3
IGAAN	-	-	-	5.2	-	-	5.7	4.8	-	-	-	3.7	3.5	-	5.5
JONKA	-	-	-	1.6	4.2	3.1	6.0	4.0	-	5.9	-	-	4.9	4.7	5.7
	-	-	-	3.1	4.5	3.5	5.9	5.8	-	5.9	-	0.8	3.2	4.3	5.8
KACJA	-	5.0	-	-	-	6.0	-	-	-	5.7	-	-	1.5	-	-
	-	5.9	3.8	-	-	5.7	2.0	-	-	4.3	-	-	3.2	-	1.1
	-	5.2	-	-	-	6.2	-	-	-	6.1	-	-	1.9	-	-
	-	5.2	-	-	-	6.2	-	-	-	6.1	-	-	-	-	-
KOSDE	-	7.5	-	-	-	-	7.2	7.4	6.9	6.4	6.8	7.9	7.9	7.8	7.8
	-	7.9	7.9	7.4	7.9	7.8	7.9	7.8	7.8	7.8	7.8	7.8	7.8	7.3	6.8
	8.4	8.3	8.2	7.2	8.3	8.4	8.5	7.9	7.3	6.9	7.2	8.4	8.4	8.0	8.4
	-	7.9	7.9	7.3	7.9	7.9	7.9	7.4	6.9	6.4	7.8	7.8	7.8	7.3	6.8
LOJTO	-	4.9	5.4	5.3	5.6	5.4	5.5	-	3.9	1.9	4.9	5.0	-	-	0.7
LOPAL	6.0	4.5	6.6	1.0	0.7	-	7.6	5.8	-	-	-	-	-	3.1	-
MACMA	2.0	5.2	5.1	5.1	5.1	2.7	5.0	5.0	0.2	3.8	4.9	4.9	1.8	-	2.0
	2.4	3.9	4.6	5.1	5.1	4.5	5.1	5.0	-	2.0	4.9	5.0	2.0	-	2.0
	-	4.2	4.7	5.2	5.1	4.7	5.0	5.1	-	2.9	4.8	4.9	1.3	-	2.9
	3.2	3.8	4.9	5.1	5.1	4.5	5.0	5.0	-	2.8	4.9	4.9	-	-	-
MARGR	-	-	-	-	-	-	-	6.3	-	-	-	3.1	-	1.5	7.7
MARRU	7.0	-	-	7.4	5.0	7.4	7.3	-	5.3	7.2	7.3	6.8	7.2	6.6	7.2
	0.6	1.8	6.1	5.7	1.9	1.5	7.5	1.0	-	7.3	1.8	-	7.3	4.7	6.2
MASMI	-	-	-	-	1.4	2.2	2.1	1.9	1.9	1.9	1.8	-	-	0.5	0.9
MOLSI	-	3.6	4.7	-	0.9	1.3	3.5	1.2	0.9	1.4	0.5	3.2	0.6	-	0.3
	-	4.0	4.9	0.8	5.4	5.4	5.3	-	5.3	5.3	-	5.3	0.2	-	-
	-	3.3	4.2	0.6	5.0	5.2	4.0	-	1.7	5.1	-	3.2	-	-	-
	4.2	3.0	4.3	4.3	4.3	4.3	4.3	2.3	4.1	4.1	4.0	-	-	1.8	3.0
	4.5	2.8	4.4	4.5	4.3	4.4	4.4	2.7	4.1	4.2	4.0	-	-	2.0	3.9
	-	-	-	-	-	-	-	-	-	-	-	-	-	0.8	-
	4.6	3.0	4.3	4.6	4.4	4.6	4.5	2.2	4.1	4.3	3.6	-	-	1.7	3.4
MORJO	-	3.7	3.2	-	3.7	5.5	6.0	6.0	2.1	5.9	-	2.4	5.9	5.9	5.6
MOSFA	-	-	-	0.2	-	0.3	0.6	0.2	0.2	1.5	-	0.8	-	-	-
OTTMI	-	6.0	0.3	6.8	6.3	7.0	-	6.7	0.6	6.4	6.9	1.0	-	6.9	0.5
PERZS	6.1	4.4	6.3	2.5	0.6	6.2	6.2	4.9	-	6.1	-	2.0	5.3	1.8	6.1
ROTEC	3.7	-	0.2	0.8	1.4	3.8	1.0	0.3	1.0	-	-	-	-	1.7	0.9
SARAN	7.6	4.7	6.0	2.4	2.8	7.8	7.4	7.4	0.3	7.0	1.6	-	1.7	0.9	0.7
	7.2	-	-	2.7	1.4	7.6	7.5	7.2	-	7.3	1.0	-	7.6	-	5.3
	7.0	-	6.7	3.6	2.9	-	7.2	7.0	-	7.4	2.4	-	7.4	-	6.4
	6.8	5.7	6.8	1.1	2.9	7.7	7.3	7.2	-	-	-	-	-	-	-
SCALE	-	2.6	-	-	3.5	6.2	5.2	-	-	3.0	-	3.1	-	-	-
SCHHA	-	-	1.6	3.3	1.7	3.7	-	4.4	4.6	-	0.5	-	-	0.6	4.3
SLAST	-	5.6	5.9	5.2	-	5.6	1.6	-	-	5.2	-	0.2	1.5	-	-
	-	6.4	0.4	0.4	-	0.3	-	-	-	3.8	-	-	-	-	2.7
STOEN	-	4.0	0.2	0.2	0.6	6.5	5.8	-	0.2	1.8	2.7	1.7	-	-	0.3
	0.3	4.2	0.2	-	0.4	6.6	5.5	-	-	2.6	2.8	-	0.4	-	0.2
	0.2	5.3	0.3	0.5	0.5	6.6	5.4	-	0.3	2.0	2.5	1.4	0.2	-	0.2
STRJO	-	-	3.9	4.8	4.4	4.7	4.1	1.4	4.6	2.8	0.9	-	-	2.2	1.8
	-	-	4.0	4.3	4.3	2.2	3.2	1.4	4.0	1.1	1.1	-	-	1.2	1.0
	-	-	4.8	3.4	4.7	4.7	3.8	-	4.1	-	3.7	-	-	-	2.0
	-	-	4.0	4.6	1.9	4.7	4.3	1.4	4.6	2.6	4.0	-	-	2.0	2.0
	-	-	3.8	4.0	3.3	4.2	4.0	1.4	4.6	2.8	3.8	0.2	-	2.3	0.8
TEPIS	4.8	-	-	3.6	-	5.2	5.6	5.6	-	5.5	-	-	3.7	1.9	5.5
	4.1	-	4.9	3.5	1.6	4.7	5.3	4.6	0.9	5.5	-	-	4.0	1.7	5.3
TRIMI	-	1.0	3.0	1.6	-	1.1	-	0.3	-	1.1	-	-	0.2	-	1.1
Sum	164.5	204.8	228.9	214.5	195.1	343.2	349.3	221.6	158.9	283.4	177.9	134.7	169.3	156.5	207.3

June	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
ARLRA	-	2.3	3.7	3.6	-	2.8	3.8	4.0	3.9	0.9	3.8	2.4	3.6	3.9	3.9
BERER	-	-	5.2	-	-	-	4.7	5.4	-	-	-	-	4.7	5.7	5.1
BOMMA	4.0	6.4	1.5	2.4	6.2	5.9	6.0	6.4	6.4	6.2	6.7	4.9	3.5	4.3	6.2
BREMA	0.2	-	-	3.9	-	-	2.5	-	-	3.8	4.3	4.1	-	-	1.4
BRIBE	0.5	1.3	-	4.5	-	-	4.0	1.1	-	3.6	3.8	1.7	-	-	1.9
	-	2.4	-	4.4	0.6	0.3	4.2	-	0.9	4.0	3.6	0.3	-	-	1.2
CASFL	1.8	6.4	-	1.6	1.4	1.6	6.3	6.4	6.2	3.9	2.5	5.5	5.5	5.9	5.1
	-	6.2	-	3.1	-	2.8	6.1	6.1	5.9	3.0	1.7	5.8	3.9	3.9	4.3
CRIST	0.8	5.0	-	3.1	1.6	4.4	5.7	6.2	6.2	6.2	6.0	6.2	6.2	5.2	6.2
	-	5.0	-	2.0	2.3	4.4	5.9	6.2	6.0	3.1	2.4	6.2	6.2	4.1	4.4
	1.5	5.9	-	5.3	2.2	4.4	6.1	6.2	6.2	-	6.1	6.2	6.2	4.9	6.2
DONJE	5.2	6.2	-	2.7	6.7	6.4	6.6	6.4	6.6	6.5	6.8	5.6	5.4	4.4	6.5
ELTMA	-	6.2	-	0.7	1.4	4.3	6.0	5.8	5.4	5.0	5.1	4.9	-	6.0	2.0
FORKE	-	2.0	3.5	-	-	0.2	4.8	4.9	4.4	-	3.2	0.3	-	4.2	4.5
GONRU	7.2	7.1	7.1	7.2	7.1	7.0	1.9	2.4	1.4	7.0	7.1	7.1	5.3	7.2	-
	7.2	7.3	7.3	7.3	7.3	7.3	2.0	0.7	0.9	7.0	7.3	7.3	5.4	7.3	-
	7.0	6.9	7.0	6.9	6.9	6.9	-	-	0.9	7.0	7.1	7.2	4.5	7.0	-
	6.7	7.2	7.2	7.3	7.2	7.2	-	2.4	1.3	6.8	7.3	7.3	5.6	7.0	-
	7.1	6.0	6.9	7.0	6.7	6.2	-	2.1	1.0	6.5	7.0	7.0	4.4	7.1	-
GOVMI	5.8	4.4	2.4	-	5.4	5.2	5.3	1.7	5.0	-	2.7	3.2	5.7	5.8	5.4
	5.5	3.2	2.4	-	4.5	4.8	5.3	5.8	4.7	-	2.5	1.9	5.8	5.8	5.2
	4.9	4.2	1.8	-	4.5	4.9	5.0	4.7	3.8	-	-	2.9	5.5	5.7	5.0
HERCA	7.9	7.9	8.2	7.7	7.5	-	-	-	-	5.9	-	1.1	4.9	1.7	-
IGAAN	4.8	4.4	5.4	-	5.3	-	-	-	-	3.6	-	-	4.7	5.5	5.4
JONKA	-	5.2	5.7	-	5.8	5.0	5.8	5.8	3.9	1.7	-	1.7	5.1	5.9	4.6
	2.7	5.0	5.7	-	5.7	5.3	5.8	5.8	5.0	5.7	-	2.1	4.0	5.9	4.8
KACJA	-	4.4	4.9	-	5.5	5.5	5.7	1.7	5.6	-	-	5.5	5.9	6.0	5.6
	-	2.8	3.0	-	3.2	5.1	3.9	3.8	5.9	-	1.5	5.4	5.6	6.3	5.8
	-	4.8	5.5	-	6.1	5.5	5.9	1.3	5.4	-	-	5.8	6.1	6.3	5.7
	-	-	-	-	6.0	5.9	6.0	1.9	5.5	-	-	5.8	6.0	6.2	5.3
KOSDE	7.2	7.2	5.6	7.8	7.8	7.1	5.3	7.6	5.8	6.8	-	-	7.6	7.9	7.2
	3.1	5.7	4.7	3.0	1.5	1.8	-	3.2	-	4.5	5.0	6.0	6.5	7.5	-
	8.0	8.4	6.1	8.4	8.4	7.9	7.9	7.4	8.0	8.3	0.5	8.1	8.2	8.3	7.6
	2.8	5.9	4.8	4.3	7.8	7.5	7.8	7.8	7.8	7.8	7.9	7.8	7.9	7.9	-
LOJTO	-	4.4	5.3	-	-	3.5	-	5.0	4.8	4.9	-	-	-	3.3	-
LOPAL	6.2	6.2	7.5	-	7.4	7.4	4.7	5.4	-	7.2	7.4	7.3	6.3	7.4	-
MACMA	3.6	4.8	2.9	-	2.1	4.1	4.6	2.7	4.8	4.8	1.5	-	4.9	4.9	4.8
	3.4	4.3	4.2	-	2.9	3.3	-	3.2	5.0	5.0	0.3	-	5.1	5.1	5.1
	3.8	4.7	4.6	-	0.3	1.3	4.0	2.2	4.5	4.6	-	-	4.6	4.6	4.0
	-	-	-	0.2	2.9	3.8	4.8	2.9	4.8	4.8	1.0	-	4.9	4.9	4.8
MARGR	0.9	6.2	3.7	-	-	-	-	-	5.1	1.0	-	-	-	-	0.8
MARRU	7.2	7.2	7.2	7.1	7.0	7.1	7.1	5.6	4.0	7.2	7.2	7.1	7.1	7.2	2.7
	7.1	7.2	7.3	5.8	7.3	7.3	7.3	7.0	3.8	7.2	7.4	7.2	6.0	7.1	-
MASMI	1.6	1.6	-	1.5	-	0.3	-	-	1.6	1.3	1.3	-	1.8	-	-
MOLSI	-	1.2	-	1.2	-	0.2	0.5	2.6	-	-	-	-	4.0	4.0	2.3
	-	5.1	-	0.2	0.2	-	4.0	5.2	1.8	2.9	-	-	4.0	5.1	2.6
	-	4.4	-	-	-	-	4.8	4.8	1.1	1.4	-	-	0.3	4.7	2.1
	-	4.0	3.7	4.0	-	3.3	4.0	3.9	3.9	-	4.0	0.3	3.8	3.8	3.8
	-	4.0	3.7	4.0	-	2.3	3.9	3.9	4.0	-	4.0	-	3.7	4.0	3.9
	-	-	3.9	-	-	-	-	-	-	-	-	-	-	-	1.0
	-	3.7	3.8	4.2	-	2.3	4.2	4.3	4.2	-	4.3	0.2	3.8	4.0	3.9
MORJO	-	5.7	5.9	1.3	5.6	4.1	5.9	5.8	5.4	5.7	-	0.6	5.9	5.9	4.5
MOSFA	0.7	1.0	-	-	-	-	0.8	0.8	0.7	0.2	0.5	0.7	0.9	0.3	-
OTTMI	6.9	3.5	6.6	6.8	1.7	0.7	6.4	6.8	0.4	1.8	6.8	6.9	6.9	6.4	4.6
PERZS	5.9	2.6	0.7	-	4.2	3.7	3.0	5.9	5.8	-	2.4	5.8	-	-	-
ROTEC	-	-	0.2	1.1	-	-	1.8	2.4	3.5	-	3.6	2.0	0.8	3.6	2.4
SARAN	1.3	-	-	-	-	-	-	2.9	3.0	7.2	7.0	7.6	6.3	7.6	0.6
	6.3	7.5	-	7.5	7.5	-	5.6	4.1	-	2.5	7.0	7.5	-	7.6	-
	7.1	7.2	-	7.3	7.2	-	6.6	4.7	1.4	3.0	6.6	7.1	-	7.4	-
	-	-	-	-	0.7	5.4	1.3	6.1	2.0	7.2	2.3	7.3	6.8	7.5	-
SCALE	-	6.0	1.7	1.5	3.1	4.3	6.1	6.1	5.9	4.7	3.7	4.2	6.3	6.0	2.6
SCHHA	-	1.6	-	4.1	-	1.5	3.1	-	1.3	2.9	1.3	-	-	-	2.0
SLAST	-	4.5	5.1	-	3.8	4.9	4.4	3.9	5.2	-	-	5.4	4.6	5.4	4.5
	-	5.5	5.9	-	4.4	5.8	5.0	5.0	5.8	-	-	5.1	5.8	6.2	4.8
STOEN	-	6.4	0.9	0.2	3.2	3.3	6.3	6.2	4.5	4.2	2.2	5.0	6.4	6.1	1.2
	-	6.5	1.3	1.6	3.5	4.0	6.3	6.2	5.4	4.4	2.0	5.3	6.4	6.1	1.7
	-	6.4	2.0	1.6	4.1	3.9	6.5	6.2	4.1	3.9	2.0	4.8	6.3	6.1	1.5
STRJO	-	1.2	-	4.3	-	-	4.3	1.3	-	-	3.6	3.6	-	-	1.9
	-	1.7	-	3.7	-	-	4.2	-	-	-	2.6	2.2	-	-	1.3
	-	-	-	4.4	-	-	4.5	-	0.2	-	3.3	1.1	-	-	0.8
	-	1.7	-	0.6	-	-	1.5	1.3	-	-	-	2.8	-	-	1.6
	-	1.2	-	-	-	0.3	4.2	0.6	0.2	-	3.4	2.2	-	-	1.2
TEPIS	5.5	5.0	5.4	-	-	5.4	5.4	5.4	5.0	4.6	4.2	-	5.5	5.5	5.5
	5.5	3.9	5.3	-	4.2	5.4	5.4	5.4	4.1	4.5	4.2	-	5.5	5.5	1.4
TRIMI	0.8	0.5	3.4	-	2.7	2.5	4.2	1.0	2.2	-	-	1.7	2.9	2.4	1.4
Sum	175.7	311.9	217.8	178.4	228.6	245.0	303.0	278.0	249.5	233.9	219.0	258.3	297.5	346.5	213.8

3. Results (Meteors)

June	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15
ARLRA	8	3	22	12	20	24	26	15	17	16	11	-	-	7	24
BERER	-	-	-	-	-	-	27	20	-	-	-	-	-	-	-
BOMMA	-	4	9	3	8	18	20	-	-	9	6	14	8	14	3
BREMA	3	-	6	11	1	2	1	-	4	-	8	-	-	9	-
BRIBE	-	-	5	6	9	6	4	3	9	-	-	-	-	4	12
	-	-	3	1	6	5	5	5	10	-	-	-	-	3	13
CASFL	-	-	2	12	-	17	5	-	9	-	9	6	-	2	-
	-	-	2	5	1	11	1	-	4	-	3	3	-	-	-
CRIST	18	-	-	3	3	10	9	1	11	8	-	18	4	14	-
	18	-	-	-	4	5	3	-	14	11	-	11	2	4	-
	27	-	-	10	1	21	18	6	24	18	-	26	5	23	-
DONJE	1	6	16	-	5	23	25	-	-	15	8	20	6	23	-
ELTMA	-	-	-	-	7	11	6	-	-	6	7	-	1	-	-
FORKE	-	-	-	-	22	17	15	-	9	4	-	-	-	-	22
GONRU	20	9	6	24	1	27	22	25	9	32	18	1	25	18	11
	20	5	7	13	2	-	26	18	5	20	11	-	16	11	14
	4	4	-	5	1	6	5	2	2	5	4	1	5	1	9
	15	13	6	15	-	25	18	16	8	17	11	-	19	12	14
	16	3	7	5	1	14	18	19	2	15	10	4	21	9	19
GOVMI	9	7	16	-	1	9	6	1	-	10	-	-	2	4	15
	6	5	4	3	1	1	6	1	-	16	2	1	7	1	7
	2	8	7	3	1	3	5	1	-	10	1	-	4	2	10
HERCA	1	19	23	14	10	13	18	12	9	2	9	20	13	15	17
IGAAN	-	-	-	3	-	-	5	1	-	-	-	3	2	-	4
JONKA	-	-	-	1	2	1	5	7	-	15	-	-	6	5	5
	-	-	-	3	3	4	9	5	-	10	-	2	10	7	5
KACJA	-	25	-	-	-	15	-	-	-	15	-	-	4	-	-
	-	11	3	-	-	14	2	-	-	10	-	-	4	-	5
	-	21	-	-	-	21	-	-	-	26	-	-	3	-	-
	-	12	-	-	-	10	-	-	-	11	-	-	-	-	-
KOSDE	-	65	-	-	-	-	61	65	61	59	59	64	59	81	71
	-	75	81	55	90	83	71	82	82	90	77	70	86	73	98
	82	83	72	38	84	91	83	93	81	75	83	89	82	94	63
	-	73	75	41	79	84	88	79	70	63	58	77	90	74	60
LOJTO	-	3	11	9	12	18	15	-	14	2	11	18	-	-	2
LOPAL	2	4	1	1	1	-	4	1	-	-	-	-	-	2	-
MACMA	6	12	10	10	23	19	17	24	1	4	29	14	1	-	12
	4	7	5	15	15	15	11	7	-	2	12	14	5	-	8
	-	2	2	7	6	9	6	5	-	1	5	7	2	-	1
	4	9	9	16	17	13	18	7	-	6	16	21	-	-	-
MARGR	-	-	-	-	-	-	-	6	-	-	-	3	-	2	6
MARRU	12	-	-	15	5	10	10	-	6	12	14	16	19	14	12
	4	2	3	10	3	4	6	2	-	9	3	-	14	4	6
MASMI	-	-	-	-	1	10	6	3	3	4	5	-	-	1	5
MOLSI	-	6	18	-	5	5	7	1	10	6	2	8	2	-	1
	-	2	2	1	8	12	1	-	10	7	-	8	1	-	-
	-	7	6	3	15	20	4	-	4	9	-	6	-	-	-
	11	14	15	22	18	40	24	8	19	30	15	-	-	6	23
	13	15	12	11	18	27	23	8	17	14	6	-	-	4	13
	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
	11	15	11	16	23	29	19	4	19	19	9	-	-	4	14
MORJO	-	3	1	-	5	8	6	9	1	9	-	1	8	2	4
MOSFA	-	-	-	1	-	2	3	1	1	1	-	2	-	-	-
OTTMI	-	10	2	8	10	10	-	5	1	8	8	3	-	13	3
PERZS	22	12	21	7	1	21	19	5	-	18	-	6	18	4	14
ROTEC	4	-	1	2	5	8	3	1	2	-	-	-	-	4	1
SARAN	8	8	5	4	7	9	9	9	1	10	2	-	9	4	4
	7	-	-	6	4	7	18	8	-	9	2	-	16	-	11
	7	-	17	8	12	-	15	14	-	23	3	-	16	-	10
	2	6	4	1	2	6	5	6	-	-	-	-	-	-	-
SCALE	-	3	-	-	2	3	2	-	-	1	-	1	-	-	-
SCHHA	-	-	4	1	1	2	-	7	10	-	2	-	-	3	19
SLAST	-	14	10	9	-	17	1	-	-	11	-	1	4	-	-
	-	11	3	3	-	2	-	-	-	4	-	-	-	-	2
STOEN	-	11	1	2	4	27	15	-	1	2	13	10	-	-	1
	2	8	1	-	1	22	15	-	-	5	5	-	2	-	1
	2	21	2	3	4	27	13	-	1	4	8	7	1	-	1
STRJO	-	-	14	14	14	11	14	1	14	7	2	-	-	11	3
	-	-	18	6	8	2	7	2	8	1	3	-	-	3	5
	-	-	6	7	2	3	1	-	6	-	3	-	-	-	1
	-	-	5	6	3	6	7	1	4	1	4	-	-	3	2
	-	-	7	10	6	5	4	1	13	4	10	1	-	8	1
TEPIS	5	-	-	3	-	4	9	6	-	1	-	-	4	2	5
	10	-	9	10	1	6	11	8	1	8	-	-	10	3	12
TRIMI	-	3	6	6	-	2	-	1	-	6	-	-	1	-	2
Sum	386	659	614	539	625	1032	961	638	607	846	587	577	617	608	706

June	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
ARLRA	-	5	13	14	-	12	29	25	19	2	29	11	18	31	18
BERER	-	-	16	-	-	-	26	18	-	-	-	-	14	35	12
BOMMA	13	25	2	12	24	16	13	20	20	18	32	17	15	13	22
BREMA	1	-	-	8	-	-	7	-	-	5	5	3	-	-	2
BRIBE	2	3	-	11	-	-	15	3	-	9	8	2	-	-	6
	-	2	-	12	1	1	8	-	2	9	4	2	-	-	4
CASFL	3	22	-	10	4	4	18	20	19	4	6	11	12	11	16
	-	9	-	3	-	2	16	10	12	5	4	17	9	6	8
CRIST	4	19	-	5	3	17	17	27	18	10	12	32	22	14	19
	-	12	-	15	2	21	16	18	18	8	2	17	17	10	4
	5	40	-	26	2	21	39	37	33	-	24	43	37	22	33
DONJE	19	21	-	8	31	18	29	18	24	31	31	15	22	11	26
ELTMA	-	17	-	4	7	10	14	13	11	6	11	12	-	15	5
FORKE	-	4	10	-	-	1	19	18	23	-	4	1	-	13	19
GONRU	21	24	31	29	34	24	2	4	7	21	24	40	16	28	-
	17	10	27	21	23	18	1	1	2	16	23	21	16	23	-
	7	4	7	7	10	7	-	-	1	5	3	11	4	9	-
	23	25	16	19	20	19	-	3	2	6	19	27	10	21	-
	15	18	23	15	14	12	-	5	2	13	23	18	9	23	-
GOVMI	10	8	1	-	14	16	8	3	8	-	8	9	16	17	20
	1	2	3	-	4	4	5	6	16	-	1	2	13	14	15
	6	6	4	-	5	6	9	7	4	-	-	8	11	13	12
HERCA	15	10	14	18	9	-	-	-	-	4	-	2	8	1	-
IGAAN	4	1	1	-	1	-	-	-	-	2	-	-	1	5	2
JONKA	-	9	5	-	8	4	5	5	3	2	-	2	9	11	4
	4	6	3	-	4	2	4	8	8	4	-	2	5	14	12
KACJA	-	16	21	-	19	19	20	5	23	-	-	8	35	36	32
	-	6	9	-	5	23	10	4	22	-	4	13	27	23	21
	-	24	35	-	36	29	22	3	16	-	-	42	37	53	32
	-	-	-	-	19	10	16	2	8	-	-	8	25	13	14
KOSDE	59	55	46	62	62	54	26	38	44	44	-	-	71	74	61
	15	58	43	49	19	12	-	2	-	19	42	67	47	88	-
	62	74	33	39	46	34	14	37	43	56	3	91	101	92	94
	10	64	59	33	52	18	46	20	34	54	78	76	85	90	-
LOJTO	-	20	9	-	-	4	-	14	13	17	-	-	-	7	-
LOPAL	8	1	3	-	6	5	1	5	-	3	4	2	1	4	-
MACMA	12	15	16	-	2	12	9	8	15	17	2	-	22	23	11
	10	15	13	-	7	7	-	7	18	18	2	-	26	21	9
	2	5	5	-	1	5	5	3	7	9	-	-	21	10	5
	-	-	-	1	6	10	17	8	16	16	2	-	24	19	18
MARGR	1	2	4	-	-	-	-	-	5	6	-	-	-	-	5
MARRU	9	19	22	22	15	16	14	7	4	13	17	14	22	23	2
	5	12	18	18	19	14	14	13	7	10	7	12	5	20	-
MASMI	5	3	-	1	-	1	-	-	5	5	2	-	10	-	-
MOLSI	-	5	-	9	-	1	3	10	-	-	-	-	31	27	19
	-	12	-	2	1	-	12	19	1	3	-	-	8	10	7
	-	16	-	-	-	-	20	16	2	1	-	-	2	19	9
	-	20	28	26	-	14	35	24	35	-	34	1	36	26	25
	-	14	11	18	-	6	26	22	21	-	31	-	17	25	25
	-	-	11	-	-	-	-	-	-	-	-	-	-	-	8
	-	13	14	16	-	6	22	21	20	-	20	1	15	26	22
MORJO	-	7	6	2	5	1	5	6	3	5	-	1	6	6	3
MOSFA	1	6	-	-	-	-	5	5	4	1	3	5	5	2	-
OTTMI	2	9	6	9	3	3	6	20	2	12	9	6	12	11	3
PERZS	7	10	1	-	13	3	6	14	11	-	2	21	-	-	-
ROTEC	-	-	1	3	-	-	5	4	8	-	14	4	2	9	5
SARAN	7	-	-	-	-	-	-	4	5	5	11	6	9	8	1
	9	15	-	12	14	-	1	5	-	3	11	18	-	18	-
	20	16	-	24	18	-	15	21	2	7	23	13	-	32	-
	-	-	-	-	4	7	1	5	4	10	13	5	12	10	-
SCALE	-	4	1	1	3	6	5	3	8	2	4	8	10	4	3
SCHHA	-	2	-	8	-	3	10	-	1	7	1	-	-	-	2
SLAST	-	6	10	-	10	11	16	6	12	-	-	15	19	30	15
	-	10	8	-	5	6	9	5	7	-	-	15	14	5	7
STOEN	-	43	5	1	16	27	24	24	17	16	6	24	33	27	7
	-	23	6	3	8	18	31	21	16	6	7	33	26	16	5
	-	42	10	5	24	22	36	18	19	14	2	45	44	18	8
STRJO	-	4	-	9	-	-	19	2	-	-	15	10	-	-	8
	-	4	-	10	-	-	15	-	-	-	11	3	-	-	4
	-	-	-	3	-	-	1	-	1	-	5	2	-	-	4
	-	1	-	2	-	-	3	3	-	-	-	1	-	-	4
	-	1	-	-	-	1	11	1	1	-	4	2	-	-	5
TEPIS	2	4	5	-	-	1	6	8	11	8	3	-	5	12	11
	4	8	9	-	6	12	14	10	14	9	7	-	20	26	10
TRIMI	1	3	7	-	8	5	5	3	4	-	-	4	8	6	3
Sum	421	989	651	625	672	661	881	745	761	576	672	901	1177	1329	786