Results of the IMO Video Meteor Network – March 2016

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In March, the weather situation improved a little. In particular in the first half of the month we obtained longer observation series, whereas the conditions started to deteriorate again in the second half. Most cameras were active on March 17 and 26 (61 of 78 cameras). Since we were spoiled with over 10,000 observing hours in the last two years, we fell significantly short of this result with only 8,300 hours in 2016. However, the average hourly meteor count was higher than before, in particular thanks to the image-intensified cameras of Detlef Koschny on the Canary Islands. So the overall outcome of nearly 18,000 meteors was still respectable. 29 cameras managed to observe in twenty or more nights, which is a clear increase compared to February. On the other hand there was hardly any camera with less than ten nights, which hints on geographically balanced observing conditions. Only Portugal and Tucson/US deviated significantly from the average. Indeed Carl Hergenrother missed only two nights in the first quarter of 2016 with his camera SALSA3, which is another proof for the excellence of his observing site.

Since March cannot present noticeable meteor shower activity, we want to address a technical issue in this report, inspired by a presentation at the Meteoroids 2016 conference. It's about the difference between stellar and meteor limiting magnitude (lm) and the dependency from the angular meteor velocity. This difference plays a central role in the flux density determination. At first, the stellar lm is calculated every minute. Then the expected angular velocity of a shower meteor is determined for every pixel in the field of view. Based on this, the stellar is converted into a meteor limiting magnitude, the effective collection area for the meteor shower is computed, and finally the flux density determined.

It is obvious, that due to the motion the photons of a meteor are spread out over more CCD pixels that the photons of a star. The faster the meteor moves, the fewer photons remain per pixel and the smaller is the meteor limiting magnitude. For punctiform objects, the loss is inverse proportional to the angular velocity. However, stars and meteors are not punctiform objects in practice, but have a certain size. A formula was obtained for MetRec many years ago, based on the simplified assumption that all pixels have the same brightness. The formula consists of three segments: If the meteor is moving less than its own diameter within one video frame, there is no loss in limiting magnitude. If the meteor is moving fast enough, the above-mentioned inverse proportionality is valid, in-between there is a transition phase. This function depends on the minimum diameter of stars. However, in practice a constant minimum diameter was applied to all cameras, since otherwise the results varied too much between the cameras.

At the Meteoroids conference, A. Kingery and R. Blaauw presented their method to calculate the meteor limiting magnitude of a video camera. The approach is comparable to MetRec, even though the stellar limiting magnitude is calculated only every ten minutes and deviates slightly from the star field counting method of MetRec. Thereafter a transformation is applied to derive the loss in limiting magnitude, which is inversely proportional to the angular velocity. They go one step further by modelling stars and meteors with a two-dimensional Gaussian as Point Spread Function (PSF). The full width at half maximum (FWHM) in one parameter in their formula, but CCD pixels are still modelled as punctiform. That was the trigger for a more detailed analysis, how the dependency really looks like.

At first, the loss in limiting magnitude was modelled in software. It was based on a star with a radial-symmetric two-dimensional Gaussian PSF and pre-defined variance. Another assumption was a linear response of the CCD chip, i.e. that twice as many photons would generate a signal twice as strong. To save computation time, the star was discretized with 10 times the resolution of a CCD pixel. Then it was calculated in very small time steps how the star is moving during the expose of a video frame parallel to the x-axis, and how the pixels accumulate the photons (in reality the meteor is moving, not the star, but for simplicity we talk about simulating a star trail here). The velocity of the stellar motion was the second parameter of the simulation. At the end of the "exposure", both the pixel sum over the full CCD chip (which was independent of the

velocity as expected) and the brightest individual pixel were calculated. The ratio of that pixel value and the brightest pixel at velocity zero was finally the searched loss in intensity I_{vel}/I_0 and represents the loss in limiting magnitude as a function of velocity.
Figure 1 shows the simulation result for a star with a variance of 5 pixels and a velocity between 0 and 25 pixels / frame. We can see that at velocities close to zero the dependency is Gaussian shaped, and at high velocities it can be modelled by a function of type CONST/velocity. In-between there is a transition area that cannot be modelled by either of these functions. Thus, the three phases of the original MetRec model are confirmed. Furthermore, the simulation helped to derive a better functional approximation.

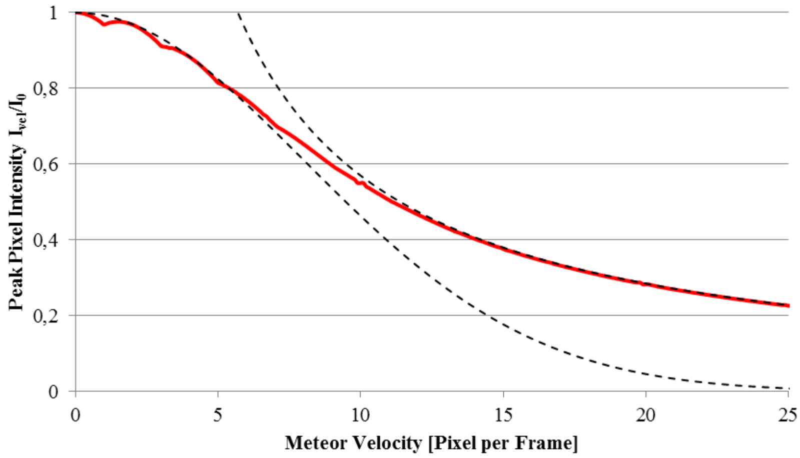

Figure 1: *Decrease of the maximum intensity of a pixel depending on the angular velocity (solid line). Dashed lines represent a Gaussian function and a function of type CONST/velocity.*

As remarked earlier, the limiting magnitude is governed by the pixel which receives most photos during the exposure. From simple considerations we conclude that it is the pixel at the center of the star trail. But how many photons does that pixel receive during the exposure? If the star is not moving, it's always the peak of the Gaussian curve that exposes the pixel (figure 2, left). If the star is moving slowly, the integral from slightly right to slightly left of the Gaussian is calculated (figure 2, center). The faster the star moves, the larger will be the integral over the Gaussian curve, i.e. also the remote areas with small values are summed up (figure 2, right). The integral is divided by the velocity, since the time that the Gaussian is spending on each pixel is getting ever shorter. That is, we are looking for the mean of the Gaussian function from right to left of the peak.

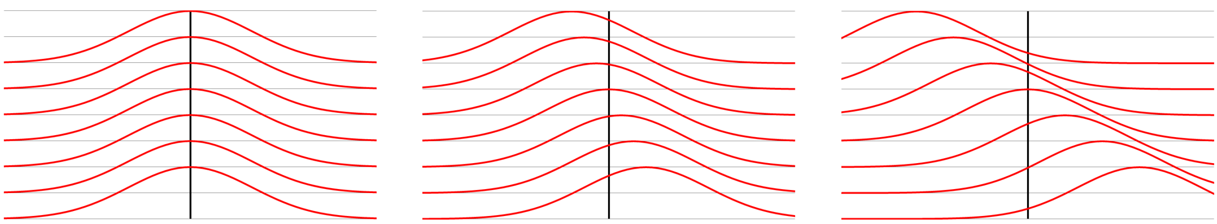

Figure 2: *Exemplary presentation of the motion of a star over the CCD pixel with maximum intensity (black line). If the star is not moving (left), always the peak of the Gaussian is accumulated. The faster the star moves (center, right), the more remote areas of the Gaussian curve are covered.*

Naturally the mean is getting smaller, the more remote areas of the Gaussian are included, as is depicted schematically in figure 3. If only the inner section is considered, the mean is identical to the peak of the Gaussian. The more areas are included, the smaller the mean gets
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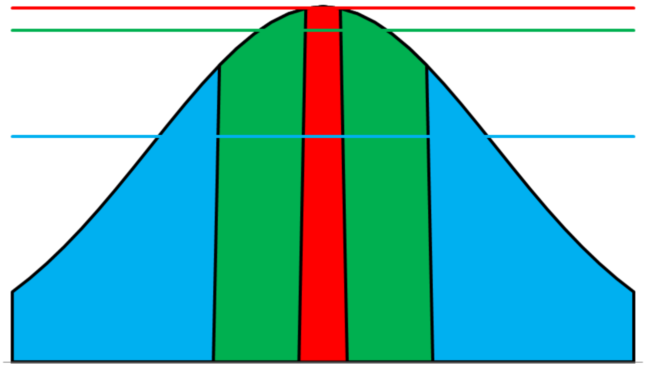

Figure 3: *The smaller the considered part of the Gaussian (marked in color), the smaller gets the mean (horizontal lines).*

Depending on the velocity *vel*, the mean can be calculated by determining the integral over the Gaussian curve (from *–vel/2* to *+vel/2*) and dividing it by the length of the segment (*vel*). The integral of a Gaussian is related to Gaussian error function *erf(x)*. That's a Sigmoid function (figure 4) with a value of -1 at $x=-\infty$, 0 at $x=0$, and +1 at $x=+\infty$.

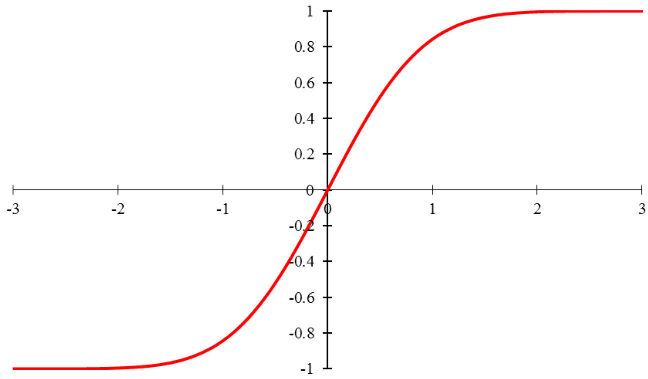

Figure 4: *The Gaussian error function erf(x) is a Sigmoid function.*

Depending on the variance *var*, the antiderivative *G(x)* is

$$(1) \qquad G(x) = \tfrac{1}{2} * (1+erf(x/\sqrt{(2*var)})$$

To calculate the integral, we have to subtract the antiderivative at $x=-vel/2$ from the antiderivative at $x=xel/2$. Since $erf(x)=-erf(-x)$ we can simplify the difference to

$$(2) \qquad G(vel/2)-G(-vel/2) = erf(-vel/2/\sqrt{(2*var)})$$

That value has to be divided by the velocity, because we want to calculate the average value of the Gauss function in the interval from *-vel/2* to *+vel/2*. Hence we obtain the mean value by

$$(3) \qquad \bar{g}_{vel} = erf(-vel/2/\sqrt{(2*var)})/vel$$

Finally we have to scale this function, since it shall yield a value of 1.0 for $vel \rightarrow 0$ (i.e. no loss in limiting magnitude when the star is not moving). The peak value of the Gauss function at $x=0$ depends on the variance and can be expressed by $g(0)=1/\sqrt{(2\pi*var)}$. So we have to divide the mean function (3) by this factor to obtained the dependency of the maximum pixel value (resp. intensity) I_{vel} relative to the maximum pixel value at velocity zero I_0

$$(4) \qquad I_{vel}/I_0=\sqrt{(2\pi*var)} * erf(vel/2/\sqrt{(2*var)})/vel$$

Figure 5 confirms that the loss in intensity obtained from the computer simulation can be approximated well by formula (4). The function is not defined for $vel=0$ (division by zero), but that doesn't matter because for $vel=0$ the ratio is unity by definition. To transform the loss in intensity I_{vel}/I_0 into a loss of limiting magnitude $lm_{vel}-lm_0$, we have to regard the logarithmic dependency between intensity I and limiting magnitude lm as $lm \sim 2.5 * \log_{10}(I)$. Thus

$$(5) \qquad lm_{vel}-lm_0=-2.5*\log_{10}(I_{vel}/I_0)$$

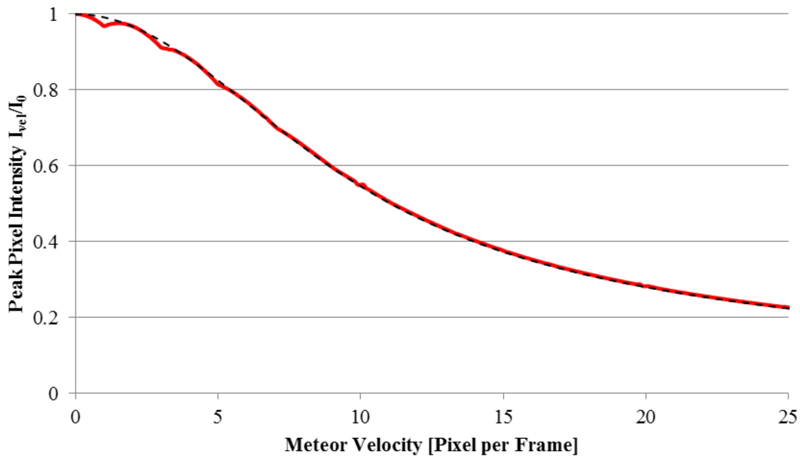

Figure 5: *Decrease of the maximum intensity of a pixel depending on the angular velocity (solid line). The dashed line represents the corresponding model according to formula (4).*

Two arbitrary examples: For a variance of 2 pixels and a velocity of 5 pixels / frame we obtain an intensity ratio I_{vel}/I_0 of 0.65. That is, the maximum intensity is reduced by about 1/3 and the loss in limiting magnitude $lm_{vel}-lm_0$ is -0.46 mag. Given a variance of 5 pixels and a velocity of 3 pixels / frame, we get $I_{vel}/I_0 = 0,93$ and $lm_{vel}-lm_0 = 0,08$ mag.

Next we repeated the simulation for Gaussian PSFs with different variances. Figure 6 shows different simulated star trails. The variance (1 to 10 pixels) is displayed in the vertical direction, and the velocities (0 to 50 pixels / frame) in the horizontal direction.

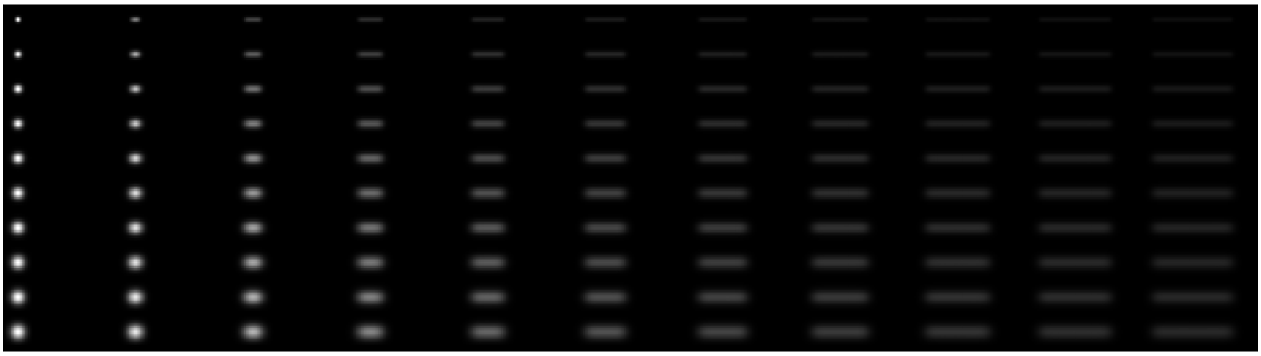

Figure 6: *Simulated star trails for different variances (from 1 in the first to 10 in the last row) and velocities (from 0 in the first to 50 in the last column).*

Figure 7 compared the intensity loss obtained from simulation with the model of formula (4). On the left side, the absolute values are given, on the right side the deviations between simulation and model. We see some numerical effects of the simulation (fluctuation at multiples of 10 pixels / frame) and two new effects. On the one hand, the intensity loss is slightly overestimated for all velocities, which becomes particularly obvious at the smallest variance value $var=0.5$. On the other hand, the ratio oscillates at very small velocities and variances.

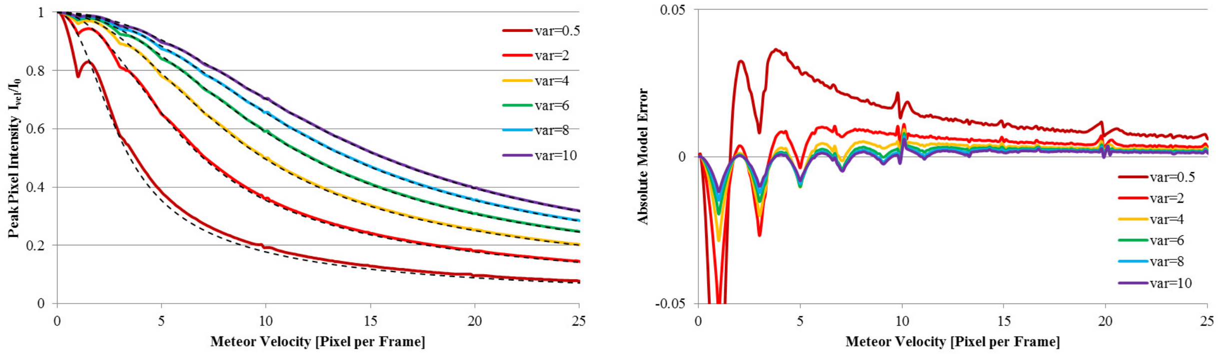

Figure 7: *Decrease of the maximum intensity of a pixel depending on the angular velocity (solid line) for Gaussian PSFs with different variances (left). Dashed lines show the corresponding model according to formula (4). On the right side, the deviation between simulation and model is shown.*

Both effects can be attributed to the fact, that CCD pixels are punctiform in the model, but have a certain size in reality (and in the simulation). This discretization has two effects:

- Even if the exposure time is reduced arbitrarily towards zero, each CCD pixel does not obtain exactly one brightness value from the Gaussian curve, but rather a small integral of the Gaussian of the size of a CCD pixel. That happens in both dimensions (x and y-axis). A precise numerical solution may be possible but it is complex and not really necessary, as the systematic error is very small. This integration effect is kind of "smearing out" the Gaussian a bit. In result we obtain a function that resembles a Gaussian with slightly larger variance. We have to add to the variance in formula (4) a small offset of 0.09 to remove the systematic deviation almost completely (figure 8).

- The strong oscillation at small variances and velocities are a kind of aliasing. The root cause is that the pixel with maximum intensity at the center of the star trail is not changing continuously, but only in certain discrete steps due to the extend of the CCD pixels. On some occasions, the peak of photons is collected by exactly one pixel, at slightly higher velocities it is shared between two neighboring pixels, and once more at slightly higher velocities it is concentrated in one pixel again. The sum over all pixels of the star trail remains unchanged, but for the limiting magnitudes only the one pixel with maximum intensity is relevant.
  Such an aliasing can be observed in other situations as well. If, for example, a thin black line is scanned, which is almost parallel to one axis, then the brightness of the line is oscillating between black and grey, because sometimes the color is focused on one pixel and sometimes it is shared between two pixels. The effect can also be measured, if an almost punctiform star moves almost exactly along one CCD line and the light is alternating shared between one or two pixels.
  Important is, that the exact position and size of these oscillations depends on where the simulation is started. In the simulation presented above, the center of the Gaussian function was located directly above the first pixel at start. If this start value is modified by a fraction of a pixel in x and/or y direction, both the shape and location of the oscillations change, but otherwise the graph remains the same. Since the variations are damped significantly at larger variances and velocities and even an error in the ratio by 0.1 yields only about a tenth of a magnitude, this oscillation can be ignored.

In result we obtain the final best approximation for the loss in intensity I_{vel}/I_0 depending on the variance and velocity:

$$(6) \qquad I_{vel}/I_0=\sqrt{(2\pi*(var+0.09))} * erf(vel/2/\sqrt{(2*(var+0.09))})/vel$$

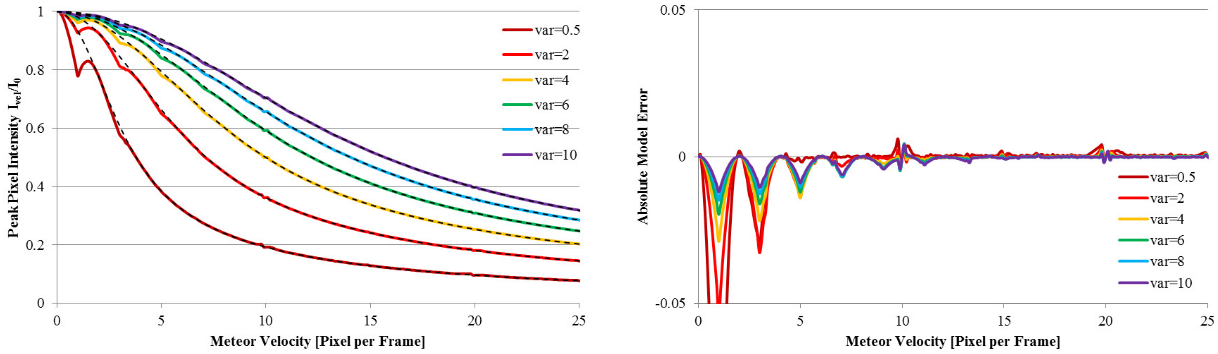

Figure 8: *Decrease of the maximum intensity of a pixel depending on the angular velocity (solid line) for Gaussian PSFs with different variances (left). Dashed lines show the corresponding model according to formula (6). On the right side, the deviation between simulation and model is shown.*

In the near future, MetRec will be adapted as follows: At first, the average variance of star images is determined for the video camera. Based on that, the loss in limiting magnitude is calculated based on formulae (5) and (6), whereby the variance is given in pixels and the velocity in pixels / frame. Strictly speaking, the formulae are valid only under the above-mentioned boundary conditions (radial-symmetric Gaussian as PSF, linear response of CCD), but it is independent of the background illumination, for example. The signal of the star has to be a certain amount above the background, but the absolute value of the background is irrelevant.

Note that T. Ott and E. Drolshagen presented a model at the IMC 2016, how the exact position of start and end point of a shutter break can be modelled by a function that depends on the Gaussian error function *erf(x)* as well. In fact, the simulation software used here has to be adapted only slightly to confirm also their model by simulation. It will be interesting to see, which effects the discretization of the CCD pixel and a variable brightness along the star trail has. That will be part of a future analysis.

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	19	85.6	317
BANPE	Bánfalvi	Zalaegerszeg/HU	HUVCSE01 (0.95/5)	2423	3.4	361	7	4.0	26
BERER	Berkó	Ludanyhalaszi/HU	HULUD1 (0.8/3.8)	5542	4.8	3847	10	22.9	152
BOMMA	Bombardini	Faenza/IT	MARIO (1.2/4.0)	5794	3.3	739	19	103.7	214
BREMA	Breukers	Hengelo/NL	MBB3 (0.75/6)	2399	4.2	699	20	136.4	154
BRIBE	Klemt	Herne/DE	HERMINE (0.8/6)	2374	4.2	678	11	79.8	140
		Berg. Gladbach/DE	KLEMOI (0.8/6)	2286	4.6	1080	15	112.9	139
CASFL	Castellani	Monte Baldo/IT	BMH1 (0.8/6)	2350	5.0	1611	19	138.0	231
			BMH2 (1.5/4.5)*	4243	3.0	371	19	126.4	205
CRIST	Crivello	Valbrevenna/IT	BILBO (0.8/3.8)	5458	4.2	1772	24	147.8	276
			C3P8 (0.8/3.8)	5455	4.2	1586	21	109.5	165
			STG38 (0.8/3.8)	5614	4.4	2007	24	170.2	530
DONJE	Donati	Faenza/IT	JENNI (1.2/4)	5886	3.9	1222	19	100.2	259
ELTMA	Eltri	Venezia/IT	MET38 (0.8/3.8)	5631	4.3	2151	11	51.1	81
FORKE	Förster	Carlsfeld/DE	AKM3 (0.75/6)	2375	5.1	2154	11	58.0	111
GONRU	Goncalves	Tomar/PT	TEMPLAR1 (0.8/6)	2179	5.3	1842	27	207.5	460
			TEMPLAR2 (0.8/6)	2080	5.0	1508	27	218.1	400
			TEMPLAR3 (0.8/8)	1438	4.3	571	24	192.9	138
			TEMPLAR4 (0.8/3.8)	4475	3.0	442	28	198.7	305
			TEMPLAR5 (0.75/6)	2312	5.0	2259	26	183.3	312
GOVMI	Govedic	Sredisce ob Dr./SI	ORION2 (0.8/8)	1447	5.5	1841	10	51.5	85
			ORION3 (0.95/5)	2665	4.9	2069	10	47.2	46
			ORION4 (0.95/5)	2662	4.3	1043	9	44.3	41
HERCA	Hergenrother	Tucson/US	SALSA3 (0.8/3.8)	2336	4.1	544	30	288.1	375
IGAAN	Igaz	Hodmezovasar./HU	HUHOD (0.8/3.8)	5502	3.4	764	20	72.0	78
		Budapest/HU	HUPOL (1.2/4)	3790	3.3	475	9	52.3	13
JONKA	Jonas	Budapest/HU	HUSOR (0.95/4)	2286	3.9	445	18	109.1	61
			HUSOR2 (0.95/3.5)	2465	3.9	715	19	96.2	79
KACJA	Kac	Kamnik/SI	CVETKA (0.8/3.8)	4914	4.3	1842	7	54.6	136
		Ljubljana/SI	ORION1 (0.8/8)	1399	3.8	268	15	82.8	79
		Kamnik/SI	REZIKA (0.8/6)	2270	4.4	840	6	45.0	137
			STEFKA (0.8/3.8)	5471	2.8	379	6	52.1	87
KOSDE	Koschny	Izana Obs./ES	ICC7 (0.85/25)*	714	5.9	1464	22	163.1	807
		La Palma / ES	ICC9 (0.85/25)*	683	6.7	2951	24	190.0	1522
		Izana Obs./ES	LIC1(2.8/50)*	2255	6.2	5670	22	136.7	1029
		La Palma / ES	LIC2 (3.2/50)*	2199	6.5	7512	23	178.6	1446
		Noordwijkerhout/NL	LIC4 (1.4/50)*	2027	6.0	4509	15	95.9	67
LOJTO	Łojek	Grabniak/PL	PAV57 (1.0/5)	1631	3.5	269	7	49.7	81
LOPAL	Lopes	Lisboa/PT	NASO1 (0.75/6)	2377	3.8	506	23	150.4	92
MACMA	Maciejewski	Chelm/PL	PAV35 (0.8/3.8)	5495	4.0	1584	15	86.8	201
			PAV36 (0.8/3.8)*	5668	4.0	1573	17	81.0	128
			PAV43 (0.75/4.5)*	3132	3.1	319	13	81.7	64
			PAV60 (0.75/4.5)	2250	3.1	281	15	77.1	159
MARGR	Maravelias	Lofoupoli/GR	LOOMECON (0.8/12)	738	6.3	2698	14	106.5	115
MARRU	Marques	Lisbon/PT	CAB1 (0.8/3.8)	5291	3.1	467	18	123.7	172
			RAN1 (1.4/4.5)	4405	4.0	1241	19	161.6	159
MASMI	Maslov	Novosimbirsk/RU	NOWATEC (0.8/3.8)	5574	3.6	773	9	33.5	131
MOLSI	Molau	Seysdorf/DE	AVIS2 (1.4/50)*	1230	6.9	6152	23	127.1	448
			ESCIMO2 (0.85/25)	155	8.1	3415	15	77.9	159
			MINCAM1 (0.8/8)	1477	4.9	1084	17	99.9	210
		Ketzür/DE	REMO1 (0.8/8)	1467	6.5	5491	21	114.7	379
			REMO2 (0.8/8)	1478	6.4	4778	23	123.0	367
			REMO3 (0.8/8)	1420	5.6	1967	11	47.8	84
			REMO4 (0.8/8)	1478	6.5	5358	19	121.7	364
MORJO	Morvai	Fülöpszallas/HU	HUFUL (1.4/5)	2522	3.5	532	22	144.8	75
MOSFA	Moschini	Rovereto/IT	ROVER (1.4/4.5)	3896	4.2	1292	14	9.4	56
OTTMI	Otte	Pearl City/US	ORIE1 (1.4/5.7)	3837	3.8	460	14	26.0	65
PERZS	Perkó	Becsehely/HU	HUBEC (0.8/3.8)*	5498	2.9	460	18	81.5	175
SARAN	Saraiva	Carnaxide/PT	RO1 (0.75/6)	2362	3.7	381	22	145.1	168
			RO2 (0.75/6)	2381	3.8	459	21	166.3	204
			RO3 (0.8/12)	710	5.2	619	22	169.2	249
			SOFIA (0.8/12)	738	5.3	907	19	145.9	151
SCALE	Scarpa	Alberoni/IT	LEO (1.2/4.5)*	4152	4.5	2052	19	72.6	76
SCHHA	Schremmer	Niederkrüchten/DE	DORAEMON (0.8/3.8)	4900	3.0	409	20	136.0	164
SLAST	Slavec	Ljubljana/SI	KAYAK1 (1.8/28)	563	6.2	1294	14	63.2	83
			KAYAK2 (0.8/12)	741	5.5	920	12	84.4	50
STOEN	Stomeo	Scorze/IT	MIN38 (0.8/3.8)	5566	4.8	3270	24	85.0	202
			NOA38 (0.8/3.8)	5609	4.2	1911	24	106.4	223
			SCO38 (0.8/3.8)	5598	4.8	3306	21	100.9	282
STRJO	Strunk	Herford/DE	MINCAM2 (0.8/6)	2354	5.4	2751	19	110.3	301
			MINCAM3 (0.8/6)	2338	5.5	3590	16	103.1	158
			MINCAM4 (1.0/2.6)	9791	2.7	552	16	83.0	88
			MINCAM5 (0.8/6)	2349	5.0	1896	17	102.6	146
			MINCAM6 (0.8/6)	2395	5.1	2178	15	97.7	128
TEPIS	Tepliczky	Agostyan/HU	HUAGO (0.75/4.5)	2427	4.4	1036	20	128.2	113
			HUMOB (0.8/6)	2388	4.8	1607	21	131.7	153
TRIMI	Triglav	Velenje/SI	SRAKA (0.8/6)*	2222	4.0	546	13	43.3	48
YRJIL	Yrjölä	Kuusankoski/FI	FINEXCAM (0.8/6)	2337	5.5	3574	18	89.6	141
Sum							31	8296.8.9	17515

* active field of view smaller than video frame

2. Observing Times (h)

March	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15
ARLRA	3.5	5.2	7.7	2.2	-	5.1	10.0	9.7	3.4	0.1	-	2.4	-	-	-
BANPE	-	-	-	-	0.6	-	-	-	-	-	-	-	-	0.3	-
BERER	-	-	-	-	-	-	-	-	-	-	-	-	-	0.2	-
BOMMA	7.6	0.4	1.4	0.7	2.9	-	1.3	-	0.6	-	-	1.1	-	8.6	-
BREMA	-	-	11.0	-	9.5	3.3	10.0	6.6	10.7	5.9	10.6	7.1	7.9	9.0	8.3
BRIBE	-	-	10.8	0.9	7.9	3.0	10.9	7.6	10.7	4.9	10.6	2.0	10.5	-	-
	-	-	10.4	-	-	-	8.6	10.7	-	8.9	10.5	2.7	10.4	9.7	5.8
CASFL	8.0	-	-	-	-	-	6.8	-	-	7.6	-	0.3	2.8	10.7	-
	5.2	-	-	-	-	-	5.1	2.7	-	5.3	-	0.5	1.3	10.5	-
CRIST	6.4	-	10.6	-	6.6	9.5	3.8	0.6	3.2	0.3	1.7	5.5	9.6	10.4	-
	5.3	0.5	11.0	-	3.6	10.7	1.6	1.0	2.4	-	0.8	3.3	1.7	10.3	-
	7.1	0.5	10.8	-	8.4	10.8	4.5	-	2.8	2.8	2.7	5.6	10.4	10.4	-
DONJE	6.8	0.7	1.3	1.6	4.7	-	2.3	-	0.9	-	-	-	-	8.4	-
ELTMA	4.8	-	-	-	-	4.1	-	-	5.8	-	-	-	-	10.5	-
FORKE	-	-	11.0	-	-	1.3	6.3	10.8	6.8	-	-	-	-	-	-
GONRU	6.9	10.0	9.0	9.0	10.6	5.4	10.0	10.0	10.1	10.7	10.6	-	10.6	-	6.4
	6.7	9.4	9.0	8.9	10.7	4.8	10.0	10.2	10.2	10.8	10.8	10.8	10.7	-	6.0
	5.3	7.9	7.5	8.3	10.5	3.6	10.8	9.6	10.3	10.7	10.6	10.6	10.6	-	5.8
	5.7	8.8	7.8	8.2	10.4	5.2	10.1	10.0	10.1	10.8	10.8	10.7	10.7	-	4.2
	6.1	8.5	7.3	8.5	10.7	3.0	10.8	9.8	9.2	10.5	10.6	10.5	10.5	-	5.5
GOVMI	3.0	-	-	-	-	-	-	-	4.2	-	-	-	-	6.2	-
	4.7	3.7	-	2.2	3.6	-	-	0.5	3.8	-	-	-	-	8.9	-
	3.7	3.5	-	-	4.2	-	-	0.6	3.6	-	-	-	-	8.3	-
HERCA	11.0	10.7	10.0	9.9	10.3	7.3	10.1	2.9	10.8	10.3	10.5	9.1	9.2	10.9	10.9
IGAAN	6.6	6.0	-	3.9	1.5	-	-	3.8	-	1.9	-	1.9	0.1	5.7	1.5
	-	-	-	-	-	-	-	9.9	0.3	-	-	-	4.2	6.5	-
JONKA	-	-	-	7.4	-	-	-	9.7	9.1	-	-	-	3.1	4.0	-
	-	-	-	7.9	-	0.3	-	10.9	7.8	1.0	-	-	2.7	-	-
KACJA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	1.4	-	-	-	-	-	-	-	-	-	7.0	4.2
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
KOSDE	-	-	-	0.2	9.9	10.0	9.5	10.3	10.3	10.2	10.2	5.4	7.6	6.6	6.1
	3.6	7.7	9.5	9.9	-	9.8	10.3	-	10.3	10.2	10.2	7.7	10.1	10.1	10.1
	-	-	-	0.2	7.8	7.5	7.6	7.8	7.7	8.0	7.8	5.7	7.5	6.5	4.7
	-	-	-	-	-	-	10.3	10.3	10.3	10.3	10.2	7.7	7.7	6.7	8.6
	-	-	-	2.6	1.8	-	2.4	-	10.2	5.2	7.7	10.0	8.0	9.8	4.9
LOJTO	-	-	-	-	-	1.6	-	-	-	-	-	-	8.5	-	-
LOPAL	-	5.1	6.4	5.3	7.7	-	8.7	9.8	-	10.8	10.9	10.8	10.8	-	8.9
MACMA	-	4.6	-	-	2.7	-	-	-	-	-	-	-	10.3	-	3.0
	-	4.2	-	-	1.6	0.2	-	-	-	-	-	-	10.3	-	2.1
	-	-	-	-	0.9	-	-	-	-	-	-	-	10.5	-	2.7
	-	4.5	-	-	-	-	-	-	-	-	-	-	10.2	-	2.6
MARGR	-	-	-	10.4	10.1	10.7	-	7.7	7.0	10.8	5.0	7.8	0.9	-	0.9
MARRU	-	-	-	-	-	-	-	-	3.3	-	9.6	9.5	8.8	-	2.7
	5.1	-	-	6.3	6.5	-	9.9	10.3	10.5	10.8	10.8	10.8	10.7	-	10.6
MASMI	-	-	0.8	1.1	4.8	-	2.2	3.7	2.6	1.4	-	-	-	-	-
MOLSI	2.6	-	2.5	-	-	7.6	4.7	10.2	10.0	10.0	1.9	-	1.3	9.4	0.9
	-	-	-	-	-	3.5	-	8.5	7.3	10.5	-	-	0.5	5.5	0.9
	-	-	1.4	-	-	6.9	1.0	9.7	10.2	10.1	-	-	-	8.3	0.8
	2.3	5.9	5.8	-	-	4.9	10.2	9.5	4.9	-	0.4	2.9	3.1	-	-
	2.6	6.7	9.9	1.7	-	4.8	10.7	10.1	5.3	0.4	0.3	3.5	3.2	-	-
	2.3	5.8	6.6	-	-	-	2.3	-	-	-	-	-	-	-	-
	2.5	6.8	10.8	-	-	4.9	10.9	10.1	5.1	-	-	3.3	2.7	-	-
MORJO	-	7.3	-	6.9	-	-	-	10.9	10.5	3.2	-	-	1.4	8.0	-
MOSFA	0.7	-	1.2	-	-	-	-	-	-	0.2	-	-	-	1.2	-
OTTMI	-	4.3	-	0.9	-	-	-	-	3.4	1.5	-	-	1.0	-	1.7
PERZS	-	-	-	-	-	4.7	-	5.9	6.0	-	2.4	-	1.8	10.0	-
SARAN	-	6.1	7.8	-	8.0	-	9.9	10.6	10.3	10.9	10.9	10.8	10.6	-	8.7
	6.4	5.7	7.7	-	7.6	-	9.5	10.6	10.3	11.0	10.9	10.7	10.6	-	10.4
	7.0	-	7.6	-	8.9	4.0	9.5	10.3	10.1	10.6	10.7	10.5	10.3	1.2	10.4
	-	6.1	7.0	-	8.6	3.5	9.7	10.6	10.2	10.9	-	10.8	10.4	-	10.4
SCALE	4.5	0.2	-	-	-	5.9	0.9	-	2.8	-	0.7	0.3	0.6	10.6	-
SCHHA	-	2.0	6.1	-	4.3	-	10.6	7.8	10.8	4.7	10.7	9.7	10.5	10.5	7.3
SLAST	4.8	-	-	-	-	-	-	-	-	1.0	-	1.2	-	10.0	4.2
	3.3	-	-	-	-	-	-	-	-	2.8	-	-	-	10.7	5.0
STOEN	7.2	-	3.1	-	0.6	3.5	1.6	-	4.7	2.0	-	0.2	2.4	9.9	0.5
	6.9	-	3.6	-	1.0	3.8	0.9	-	5.2	2.9	-	0.8	2.2	10.7	2.0
	0.8	-	3.5	0.6	1.2	4.0	1.7	-	5.1	3.0	-	-	-	10.7	1.1
STRJO	-	4.1	9.6	-	-	1.3	10.8	10.4	10.7	-	5.9	-	5.0	7.9	3.6
	-	4.7	9.1	-	-	-	10.8	10.3	10.6	-	5.7	-	5.2	8.3	3.6
	-	5.3	1.9	-	1.0	-	6.2	10.8	10.7	-	5.8	-	3.8	8.0	4.0
	-	4.1	9.3	-	-	-	10.8	9.6	10.4	-	5.8	-	-	8.2	4.0
	-	-	9.3	-	0.3	-	10.8	9.4	10.7	-	5.8	-	3.6	7.8	3.5
TEPIS	0.2	-	-	-	-	-	-	4.2	10.6	-	-	-	5.3	6.7	-
	-	0.2	-	7.3	-	3.0	-	8.7	8.6	-	-	-	4.9	6.8	-
TRIMI	11.0	-	-	3.1	2.2	-	-	-	-	-	-	-	-	9.6	1.0
YRJIL	7.7	0.4	-	-	-	-	-	-	1.6	2.7	3.0	-	-	-	3.8
Sum	195.9	177.6	277.1	137.5	214.2	183.5	337.4	385.7	415.1	278.6	264.1	224.2	349.3	376.2	214.3

March	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
ARLRA	9.4	9.3	-	1.3	-	-	-	-	2.6	-	6.0	1.8	2.3	2.4	1.2	-
BANPE	-	0.9	0.6	-	0.8	-	-	-	-	-	-	-	0.3	-	0.5	-
BERER	-	3.4	1.9	4.4	0.2	-	3.6	-	4.7	-	1.4	-	-	1.6	-	1.5
BOMMA	-	9.7	10.3	10.3	-	-	-	5.5	9.8	1.4	9.9	-	6.3	6.5	9.4	-
BREMA	10.2	4.7	-	-	-	-	-	-	-	1.9	4.2	7.3	-	2.8	1.5	3.9
BRIBE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10.2	10.0	-	-	-	-	-	0.3	-	-	7.7	6.7	-	-	-	0.3
CASFL	-	10.5	10.6	10.4	9.7	8.6	6.2	10.2	9.1	6.0	10.0	-	5.9	-	2.7	1.9
	-	10.3	10.4	10.2	9.7	9.3	2.3	10.0	9.1	7.4	9.8	-	5.1	-	2.2	-
CRIST	-	10.0	10.2	10.1	-	5.4	1.8	6.9	7.4	7.7	9.7	-	0.5	-	4.5	5.4
	-	10.2	9.9	2.4	-	7.6	3.9	4.7	-	7.4	8.7	-	-	-	-	2.5
	-	10.2	10.2	10.1	-	8.3	6.2	8.3	8.9	8.1	9.7	-	1.4	-	4.6	7.4
DONJE	-	8.4	9.0	8.9	-	-	-	4.4	8.3	1.6	9.2	-	6.6	7.1	9.8	0.2
ELTMA	-	8.3	-	2.7	-	-	-	2.5	-	0.5	7.3	-	1.4	3.2	-	-
FORKE	6.5	1.7	1.5	-	-	-	-	-	-	-	6.4	-	-	5.3	0.4	-
GONRU	9.4	3.1	4.3	-	6.2	1.5	9.9	10.0	8.4	-	7.1	3.9	2.4	7.6	4.6	9.8
	9.6	4.1	3.5	-	5.7	6.3	8.7	10.2	8.8	-	6.5	3.9	-	7.2	4.7	9.9
	9.2	-	-	-	3.7	-	8.3	10.0	8.4	-	6.8	3.5	-	7.6	3.5	9.8
	9.3	1.5	1.6	-	4.0	2.7	8.3	10.2	8.2	-	6.5	2.6	0.3	6.3	3.8	9.9
	9.0	-	-	-	3.9	4.1	4.9	7.1	4.5	-	4.2	3.4	0.4	6.6	3.9	9.8
GOVMI	1.4	9.2	10.1	-	-	-	-	-	-	-	-	2.9	2.5	5.6	6.4	-
	0.5	9.2	10.1	-	-	-	-	-	-	-	-	-	-	-	-	-
	1.1	9.2	10.1	-	-	-	-	-	-	-	-	-	-	-	-	-
HERCA	10.5	10.4	10.8	10.8	-	10.6	10.1	9.9	10.6	10.4	10.1	10.5	10.3	7.0	2.9	9.3
IGAAN	2.9	7.8	7.5	4.8	7.8	-	6.1	-	0.1	0.6	-	-	-	-	0.5	1.0
	4.4	7.7	-	10.2	8.2	-	-	0.9	-	-	-	-	-	-	-	-
JONKA	6.5	10.3	9.7	9.8	6.8	-	9.2	1.4	8.7	-	0.4	5.3	-	3.9	0.3	3.5
	5.8	9.6	7.2	1.8	4.8	3.6	6.2	1.1	9.9	-	4.7	0.5	-	2.5	7.9	-
KACJA	-	10.2	10.2	8.5	-	-	-	3.2	9.3	-	8.7	4.5	-	-	-	-
	-	7.6	10.4	10.5	7.7	-	0.6	5.6	4.2	-	6.7	4.0	2.0	4.3	-	6.6
	-	8.7	8.2	7.9	-	-	-	-	8.9	-	8.0	3.3	-	-	-	-
	-	10.4	10.4	9.1	-	-	-	-	9.0	-	8.7	4.5	-	-	-	-
KOSDE	2.6	1.1	6.9	-	-	-	-	-	6.9	0.8	9.8	9.7	9.7	9.7	-	9.6
	9.0	8.0	7.5	5.7	-	4.7	-	-	5.3	-	5.3	5.7	6.3	5.0	-	8.0
	4.1	5.0	5.4	5.7	-	-	-	-	7.0	1.1	7.4	-	7.7	7.3	-	7.2
	8.2	8.1	7.5	5.7	-	4.2	0.6	0.2	9.9	3.5	9.8	9.8	9.7	9.7	-	9.6
	9.8	4.3	-	-	-	-	-	-	-	7.7	-	3.3	-	-	-	8.2
LOJTO	10.0	-	-	-	-	-	-	8.0	9.7	-	-	7.8	-	4.1	-	-
LOPAL	8.7	-	3.8	1.8	2.9	4.7	0.8	10.3	7.6	3.5	1.2	-	0.4	-	-	9.5
MACMA	10.2	-	3.1	0.8	-	-	0.3	5.3	9.9	-	9.1	9.5	9.5	8.2	0.3	-
	9.6	-	0.8	1.4	-	0.2	0.2	5.9	9.9	0.9	7.1	9.6	9.2	7.8	-	-
	10.0	-	3.1	1.5	-	-	0.6	8.4	9.9	-	7.1	9.5	9.5	8.0	-	-
	10.2	0.4	3.1	1.5	-	0.2	0.8	7.4	9.7	-	0.3	8.7	9.3	8.2	-	-
MARGR	-	-	-	-	-	7.6	-	-	7.9	-	9.6	-	10.1	-	-	-
MARRU	7.4	5.7	5.9	-	6.2	2.6	7.0	10.3	10.2	4.8	-	-	3.8	9.3	6.7	9.9
	10.5	-	6.6	-	2.0	-	-	8.0	10.0	-	-	-	-	6.9	5.4	9.9
MASMI	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8.5	8.4
MOLSI	9.7	9.6	9.6	-	3.3	-	0.1	0.3	-	-	9.1	2.4	5.5	3.3	4.3	8.8
	10.2	10.1	10.0	-	-	-	-	-	-	-	6.8	0.8	2.9	0.2	0.2	-
	9.8	9.6	9.6	-	1.7	-	-	-	-	-	8.9	0.3	1.1	-	2.3	8.2
	10.0	9.5	-	-	3.5	-	2.4	5.8	1.5	-	9.1	8.3	4.4	5.2	5.1	-
	10.1	9.6	-	-	3.3	0.4	1.6	4.7	-	-	9.1	8.7	4.5	6.5	5.3	-
	-	-	-	-	-	0.8	3.6	-	-	-	6.3	4.1	5.0	5.8	5.2	-
	10.2	9.8	-	-	3.0	0.3	-	6.3	-	-	9.5	8.8	5.3	6.2	5.2	-
MORJO	10.1	10.4	10.1	5.8	6.4	4.6	9.3	1.8	9.8	2.2	4.7	1.1	-	6.8	9.6	3.9
MOSFA	-	1.2	1.1	0.7	0.5	-	0.2	0.7	0.5	0.2	0.7	-	-	0.3	-	-
OTTMI	2.0	-	-	2.1	0.5	-	-	0.2	-	2.1	-	3.2	-	-	0.7	2.4
PERZS	4.4	9.3	9.0	3.9	6.3	-	2.8	-	6.8	-	2.8	0.4	1.5	1.6	1.9	-
SARAN	7.9	-	1.5	-	1.6	3.6	1.0	6.8	6.9	0.5	0.1	-	-	-	0.7	9.9
	10.3	-	5.2	-	3.2	5.5	-	10.4	9.9	-	-	0.3	-	-	0.3	9.8
	9.9	-	7.2	-	3.3	5.9	1.7	10.2	10.0	-	-	-	-	-	0.3	9.6
	10.2	-	2.3	-	3.7	4.3	-	9.5	7.4	-	0.4	-	-	-	-	9.9
SCALE	1.4	7.5	8.7	4.7	-	0.2	-	4.5	2.6	4.5	9.1	-	2.9	-	-	-
SCHHA	10.2	9.8	-	-	-	-	-	0.6	-	7.2	4.7	5.7	0.4	-	-	2.4
SLAST	-	10.0	9.9	9.7	2.1	-	-	-	0.3	-	-	2.1	-	4.1	0.5	3.3
	-	10.5	10.4	10.4	7.8	-	3.4	6.8	6.4	-	6.9	-	-	-	-	-
STOEN	-	9.1	5.6	3.8	0.5	0.2	1.6	6.1	2.9	4.8	7.3	-	1.3	5.0	-	1.1
	-	10.6	8.9	6.3	0.6	0.3	1.0	10.2	3.9	7.0	8.8	-	2.2	5.3	-	1.3
	0.2	10.4	8.9	10.2	-	1.5	-	10.1	4.0	7.0	8.8	-	2.4	5.7	-	-
STRJO	10.1	8.1	-	-	-	-	-	0.5	-	-	6.0	9.3	1.6	3.7	1.3	0.4
	10.2	2.4	-	-	-	-	-	-	-	-	6.8	9.3	1.5	3.8	0.8	-
	10.2	9.1	-	-	-	-	-	-	-	-	1.3	1.1	-	3.5	0.3	-
	9.6	8.8	-	-	-	-	-	0.4	-	-	5.4	9.4	1.6	3.6	1.4	0.2
	10.2	8.8	-	-	-	-	-	-	-	-	4.4	9.3	-	3.6	0.2	-
TEPIS	9.5	10.1	10.1	3.2	8.8	3.7	9.5	4.4	9.7	-	6.4	3.1	5.2	5.0	9.1	3.4
	10.1	10.1	9.3	-	8.0	1.8	8.4	3.6	9.0	-	6.5	2.6	5.3	4.9	9.0	3.6
TRIMI	-	0.7	2.2	1.3	3.2	-	1.5	-	5.8	-	1.0	-	0.7	-	-	-
YRJIL	6.4	3.3	7.4	8.6	1.6	8.2	7.3	0.3	-	-	-	7.4	8.3	5.4	-	6.2
Sum	429.1	467.6	389.4	239.0	163.2	133.5	162.0	290.4	370.2	110.8	396.0	239.9	196.5	261.2	159.9	257.4

3. Results (Meteors)

March	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15
ARLRA	4	8	43	2	-	11	42	27	4	1	-	2	-	-	-
BANPE	-	-	-	-	4	-	-	-	-	-	-	-	-	2	-
BERER	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
BOMMA	8	1	4	5	8	-	2	-	2	-	-	1	-	14	-
BREMA	-	-	10	-	21	4	13	12	11	3	9	9	13	4	6
BRIBE	-	-	16	1	16	3	25	15	16	6	10	5	27	-	-
	-	-	10	-	-	-	10	15	-	10	5	10	27	10	1
CASFL	7	-	-	-	-	-	10	-	-	4	-	1	3	19	-
	7	-	-	-	-	-	9	8	-	3	-	4	2	15	-
CRIST	12	-	21	-	9	23	3	1	15	1	8	5	20	24	-
	13	1	19	-	3	14	2	2	7	-	5	3	2	19	-
	33	1	47	-	22	49	11	-	21	3	9	8	28	29	-
DONJE	11	3	1	5	11	-	5	-	2	-	-	-	-	26	-
ELTMA	2	-	-	-	-	12	-	-	15	-	-	-	-	20	-
FORKE	-	-	26	-	-	2	15	25	6	-	-	-	-	-	-
GONRU	11	24	15	19	26	6	34	17	34	27	39	-	36	-	12
	11	21	10	18	22	9	25	12	16	26	35	31	27	-	3
	3	10	3	3	6	1	12	4	5	12	10	7	10	-	3
	5	11	6	14	22	8	17	18	14	17	24	16	22	-	3
	7	11	5	16	15	4	19	10	23	19	24	20	16	-	4
GOVMI	7	-	-	-	-	-	-	-	6	-	-	-	-	13	-
	2	3	-	4	4	-	-	1	2	-	-	-	-	12	-
	2	1	-	-	4	-	-	1	1	-	-	-	-	8	-
HERCA	21	16	10	11	7	4	16	1	15	10	17	16	12	12	20
IGAAN	5	4	-	4	1	-	-	4	-	1	-	2	1	5	2
	-	-	-	-	-	-	-	2	1	-	-	-	1	1	-
JONKA	-	-	-	4	-	-	-	3	4	-	-	-	3	1	-
	-	-	-	4	-	1	-	6	10	1	-	-	5	-	-
KACJA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	1	-	-	-	-	-	-	-	-	-	5	3
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
KOSDE	-	-	-	1	38	54	48	52	48	53	35	38	40	38	47
	16	45	62	87	-	87	84	-	75	101	41	70	79	105	96
	-	-	-	2	54	78	49	59	63	50	85	45	56	64	65
	-	-	-	-	-	-	77	105	110	95	61	68	94	74	63
	-	-	-	5	3	-	2	-	5	4	5	7	4	6	5
LOJTO	-	-	-	-	-	12	-	-	-	-	-	-	21	-	-
LOPAL	-	4	5	4	3	-	2	3	-	7	4	5	1	-	6
MACMA	-	18	-	-	3	-	-	-	-	-	-	-	39	-	11
	-	15	-	-	1	1	-	-	-	-	-	-	18	-	4
	-	-	-	-	1	-	-	-	-	-	-	-	14	-	2
	-	17	-	-	-	-	-	-	-	-	-	-	29	-	8
MARGR	-	-	-	16	7	14	-	7	7	12	5	3	7	-	6
MARRU	-	-	-	-	-	-	-	-	11	-	15	18	16	-	1
	1	-	-	11	7	-	14	10	12	9	16	11	8	-	10
MASMI	-	-	3	5	22	-	14	25	21	11	-	-	-	-	-
MOLSI	1	-	4	-	-	29	2	51	50	44	1	-	5	28	6
	-	-	-	-	-	5	-	12	13	21	-	-	2	5	4
	-	-	2	-	-	17	1	29	21	30	-	-	-	11	3
	1	9	36	-	-	16	31	28	5	-	1	6	9	-	-
	2	15	45	2	-	5	28	31	12	2	1	10	7	-	-
	1	3	17	-	-	-	3	-	-	-	-	-	-	-	-
	2	11	46	-	-	12	32	32	10	-	-	6	7	-	-
MORJO	-	1	-	6	-	-	-	5	4	2	-	-	1	4	-
MOSFA	4	-	7	-	-	-	-	-	-	1	-	-	-	7	-
OTTMI	-	10	-	6	-	-	-	-	5	4	-	-	3	-	5
PERZS	-	-	-	-	-	4	-	5	9	-	1	-	1	24	-
SARAN	-	8	5	-	11	-	8	10	15	11	9	19	9	-	13
	3	9	8	-	13	-	19	10	12	17	20	12	10	-	19
	6	-	10	-	13	4	21	13	22	13	29	20	14	1	13
	-	7	4	-	5	1	14	11	8	12	-	23	13	-	7
SCALE	3	1	-	-	-	8	1	-	8	-	1	1	1	4	-
SCHHA	-	5	4	-	5	-	16	10	10	2	11	12	18	8	6
SLAST	14	-	-	-	-	-	-	-	-	2	-	3	-	22	4
	1	-	-	-	-	-	-	-	-	2	-	-	-	11	1
STOEN	4	-	17	-	1	5	3	-	18	4	-	1	3	21	2
	8	-	27	-	4	5	4	-	13	2	-	3	2	30	3
	2	-	19	2	3	6	6	-	28	8	-	-	-	28	1
STRJO	-	2	39	-	-	2	34	30	30	-	14	-	27	12	6
	-	5	21	-	-	-	14	23	7	-	10	-	13	9	2
	-	5	3	-	1	-	6	15	10	-	2	-	3	5	1
	-	1	11	-	-	-	4	5	34	-	8	-	-	7	2
	-	-	22	-	1	-	12	20	15	-	12	-	6	2	3
TEPIS	1	-	-	-	-	-	-	3	15	-	-	-	9	3	-
	-	1	-	6	-	3	-	5	13	-	-	-	11	6	-
TRIMI	7	-	-	1	2	-	-	-	-	-	-	-	-	12	2
YRJIL	16	1	-	-	-	-	-	-	4	4	2	-	-	-	4
Sum	264	308	663	265	399	519	819	793	973	667	584	521	855	787	488

March	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
ARLRA	45	36	-	1	-	-	-	-	1	-	25	13	19	23	10	-
BANPE	-	6	4	-	5	-	-	-	-	-	-	-	2	-	3	-
BERER	-	23	11	31	1	-	29	-	30	-	8	-	-	9	-	9
BOMMA	-	18	31	27	-	-	-	11	21	6	24	-	8	6	17	-
BREMA	11	2	-	-	-	-	-	-	-	1	3	7	-	3	1	11
BRIBE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	14	15	-	-	-	-	-	1	-	-	3	7	-	-	-	1
CASFL	-	24	31	22	19	10	13	21	7	10	18	-	6	-	5	1
	-	16	30	18	18	16	9	17	6	8	14	-	3	-	2	-
CRIST	-	23	25	28	-	12	6	6	3	8	16	-	2	-	3	2
	-	14	13	6	-	7	7	3	-	10	8	-	-	-	-	7
	-	32	37	40	-	26	16	20	15	33	33	-	2	-	7	8
DONJE	-	19	28	25	-	-	-	16	13	3	26	-	21	16	27	1
ELTMA	-	11	-	2	-	-	-	6	-	3	5	-	2	3	-	-
FORKE	10	5	1	-	-	-	-	-	-	-	15	-	-	5	1	-
GONRU	21	4	3	-	12	9	10	21	13	-	14	4	2	11	6	30
	13	7	4	-	7	11	9	11	12	-	15	5	-	7	8	25
	4	-	-	-	8	-	4	11	2	-	5	1	-	3	2	9
	15	2	2	-	6	4	6	15	7	-	12	2	2	8	6	21
	13	-	-	-	9	7	8	13	12	-	11	1	1	6	15	23
GOVMI	1	13	17	-	-	-	-	-	-	-	-	4	5	8	11	-
	1	6	11	-	-	-	-	-	-	-	-	-	-	-	-	-
	1	11	12	-	-	-	-	-	-	-	-	-	-	-	-	-
HERCA	18	15	23	10	-	10	6	7	13	10	26	6	17	4	4	18
IGAAN	3	9	7	2	3	-	2	-	13	1	-	-	-	-	3	6
	1	1	-	3	2	-	-	1	-	-	-	-	-	-	-	-
JONKA	6	9	1	5	2	-	4	2	7	-	1	4	-	2	2	1
	5	4	5	3	1	5	2	1	11	-	5	3	-	1	6	-
KACJA	-	26	41	20	-	-	-	5	21	-	21	2	-	-	-	-
	-	7	21	10	8	-	1	2	1	-	4	2	5	7	-	2
	-	35	41	27	-	-	-	-	21	-	12	1	-	-	-	-
	-	16	23	14	-	-	-	-	18	-	13	3	-	-	-	-
KOSDE	20	6	5	-	-	-	-	-	27	5	57	43	43	50	-	59
	62	77	79	40	-	43	-	-	42	-	45	40	44	38	-	64
	38	28	29	41	-	-	-	-	25	2	45	-	50	44	-	57
	75	72	51	41	-	20	2	1	37	13	88	60	85	65	-	89
	12	2	-	-	-	-	-	-	-	2	-	3	-	-	-	2
LOJTO	14	-	-	-	-	-	-	8	12	-	-	9	-	5	-	-
LOPAL	8	-	3	1	3	5	1	3	8	4	3	-	2	-	-	7
MACMA	21	-	11	1	-	-	1	8	18	-	10	21	16	22	1	-
	13	-	1	2	-	1	1	6	17	1	8	16	9	14	-	-
	4	-	1	1	-	-	1	2	9	-	7	9	7	6	-	-
	15	1	4	4	-	1	2	7	21	-	2	17	14	17	-	-
MARGR	-	-	-	-	-	15	-	-	3	-	5	-	8	-	-	-
MARRU	9	3	8	-	7	3	1	9	24	5	-	-	4	14	8	16
	8	-	5	-	1	-	-	7	6	-	-	-	-	3	5	15
MASMI	-	-	-	-	-	-	-	-	-	-	-	-	-	-	14	16
MOLSI	55	40	33	-	4	-	1	1	-	-	34	8	13	5	10	23
	20	19	26	-	-	-	-	-	-	-	20	3	7	1	1	-
	19	36	15	-	2	-	-	-	-	-	11	1	3	-	2	7
	44	46	-	-	13	-	5	16	1	-	42	20	23	20	7	-
	51	33	-	-	5	1	6	7	-	-	35	26	14	19	10	-
	-	-	-	-	-	1	6	-	-	-	16	7	12	11	7	-
	45	37	-	-	4	1	-	12	-	-	22	33	21	20	11	-
MORJO	6	7	2	1	2	1	4	1	6	2	4	4	-	3	7	2
MOSFA	-	7	7	4	3	-	1	5	3	1	4	-	-	2	-	-
OTTMI	6	-	-	6	1	-	-	1	-	2	-	8	-	-	4	4
PERZS	8	21	21	16	12	-	2	-	11	-	5	2	10	10	13	-
ROTEC																
SARAN	9	-	4	-	5	3	1	3	5	1	2	-	-	-	4	13
	13	-	1	-	2	8	-	1	6	-	-	2	-	-	2	17
	10	-	8	-	5	10	1	7	12	-	-	-	-	-	2	15
	9	-	2	-	5	5	-	4	7	-	1	-	-	-	-	13
SCALE	2	5	12	3	-	1	-	10	3	3	7	-	2	-	-	-
SCHHA	14	14	-	-	-	-	-	1	-	11	2	9	1	-	-	5
SLAST	-	11	14	2	1	-	-	-	2	-	-	3	-	2	1	2
	-	7	5	8	5	-	2	3	3	-	2	-	-	-	-	-
STOEN	-	27	13	11	3	1	2	18	2	10	19	-	3	12	-	2
	-	20	23	11	2	2	1	18	8	10	15	-	2	7	-	3
	1	31	17	18	-	3	-	33	10	24	19	-	7	16	-	-
STRJO	28	26	-	-	-	-	-	4	-	-	7	28	4	5	1	2
	21	3	-	-	-	-	-	-	-	-	6	20	1	2	1	-
	8	7	-	-	-	-	-	-	-	-	8	8	-	4	2	-
	27	17	-	-	-	-	-	2	-	-	1	18	1	5	2	1
	8	8	-	-	-	-	-	-	-	-	3	11	-	4	1	-
TEPIS	13	10	7	1	4	2	10	1	6	-	8	3	4	4	7	2
	12	18	7	-	6	2	14	1	12	-	11	1	7	4	11	2
TRIMI	-	3	6	3	2	-	1	-	2	-	3	-	4	-	-	-
YRJIL	7	3	12	12	4	13	15	1	-	-	-	12	18	5	-	8
Sum	917	1054	854	521	202	259	213	391	595	189	914	510	536	561	273	621