Results of the IMO Video Meteor Network – January 2016

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We rarely enjoy favorable observing conditions in January – only 2012 stands somewhat out from the previous years. Hence, the new observing year did not start worse than others. 76 camera provided data to the IMO network. The number was lower than before, since a few cameras had to pause because of technical problems. A quick look at the observing statistics shows in particular in the first half of January large gaps. Unfortunately, also the Quadrantids became a victim of cloudy skies at many sites. The second half of January was not optimal either, but at least a little better.
Overall only 30 cameras managed to observe in twenty or more nights, most of them in eastern and southern Europe. SALSA3 of Carl Hergenrother continued the positive series with 30 nights, and Detlef Koschny did not miss a single night thanks to the geographic spread of his cameras. In total we collected over 9,000 hours of effective observing time, which is a few percent less than in 2012 and 2015, but clearly more than in 2013 and 2014. With 28,000 meteors we could outpace the previous January by 10%, but did not reach the yield of 2012.

Compared to all other major showers of 2016 which suffer from poor lunar conditions, the Quadrantids were still quite ok with a waning moon right after the last quarter at the time of maximum. The peak was predicted for the mid-morning hours of January 4 (8:00 UT), i.e. too late to be observed by European video cameras, but close enough to their observing window to track the ascending activity branch in the morning with also increasing radiant altitude. In addition, J. Vaubaillon had predicted a possible earlier peak time between 22:00 UT on January 3 and 2:00 UT on January 4. That interval would have been perfectly located for central European observers. The weather was particularly cooperative with observers in Hungary and Poland, which is why most of the peak time data relies on their cameras.

Figure 1 shows the overview of the activity profile in 2016, compared to the previous years. The covered solar longitude interval is identical to the 2012 data set, but the flux density is almost twice as high. After we found the absolute low point of activity in 2015, the activity is significantly rising again. However, it is still quite a distance to the activity level observed in 2014

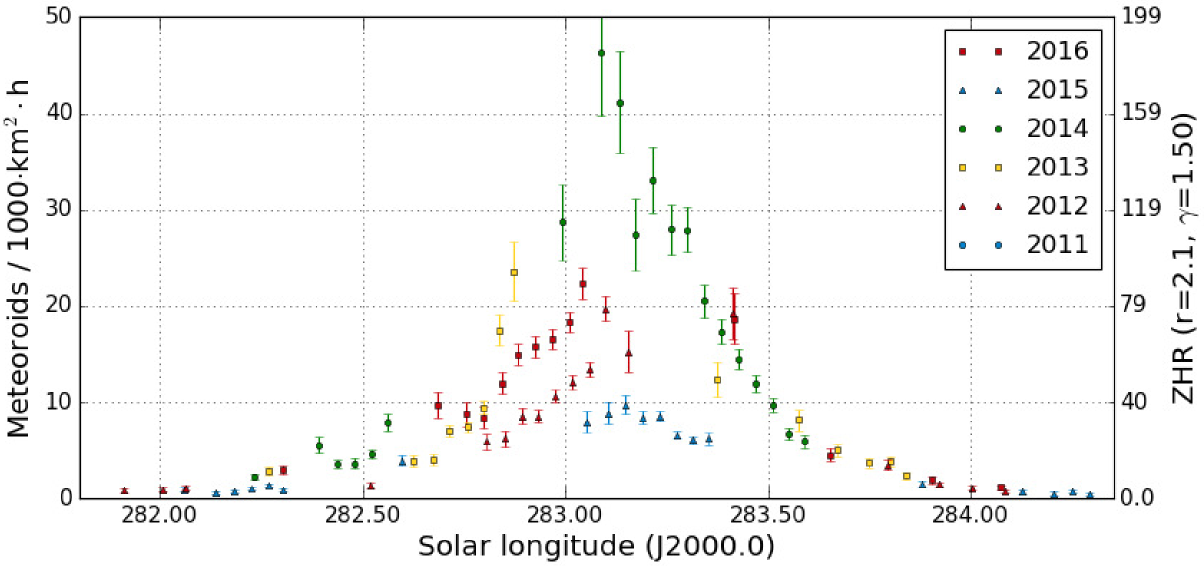

Figure 1: *Flux density profile of the Quadrantids in 2011-2016, derived from observations of the IMO video network.*

Figure 2 shows a high-resolution activity profile of the night January 3/4. It is clear that the activity was continuously rising until dawn. The supposed early peak cannot be confirmed, which was also indicated by the IMO quick look analysis of visual observations.

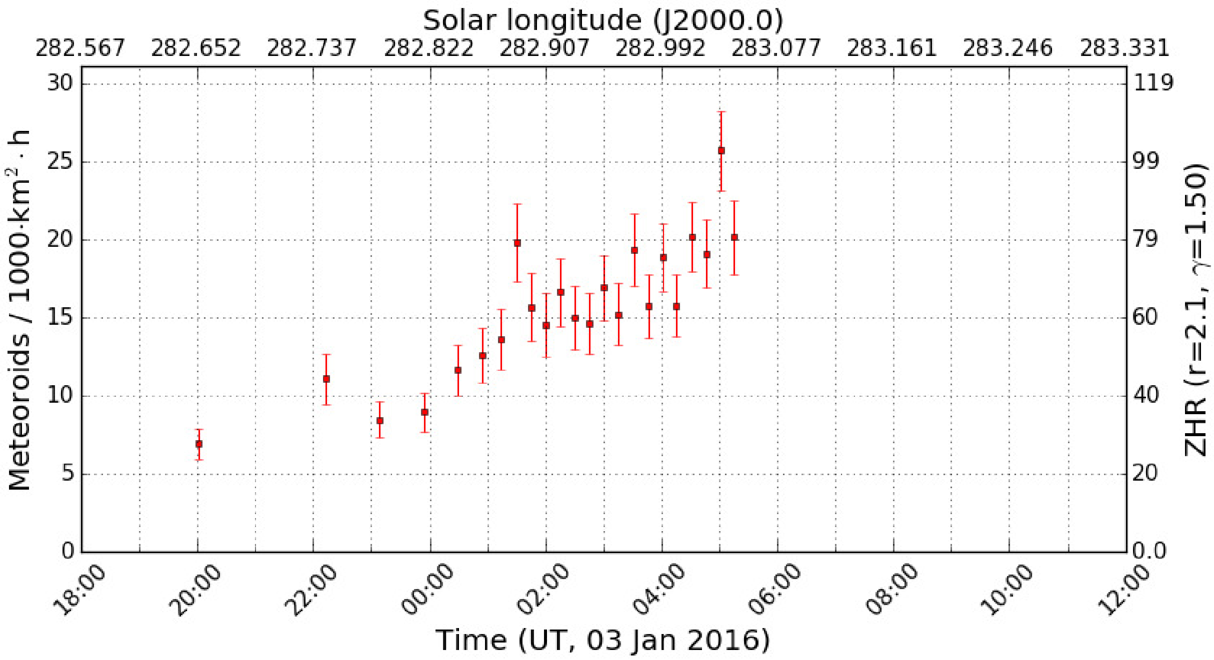

Figure 2: *High resolution flux density profile of the Quadrantids in the night of January 3/4, 2016.*

Jürgen Rendtel reported to have spotted three meteors during his visual observation on January 19, 3-5 UT, which fitted well to the gamma Ursae Minorid radiant. Three meteors are not really fireworks, but given the rapidly decreasing meteor activity in January they are at least remarkable. The minor shower of the gamma Ursae Minorids (404 GUM) was discovered 2010 by Peter Brown in den Canadian CMOR radar data and confirmed in 2013 by our analysis of IMO network video data. Based on 250 shower meteors, we detected the shower between January 18 and 24.

To confirm the activity in 2016, we re-calculated the meteor shower assignment for observations in mid-January and created a flux density profile (figure 3). The shower could indeed be identified, even though at the detection limit. In the morning of January 19, the activity was rising, reaching highest values one day later. If Jürgen had observed on January 20, he might have observed even four shower members. ☺

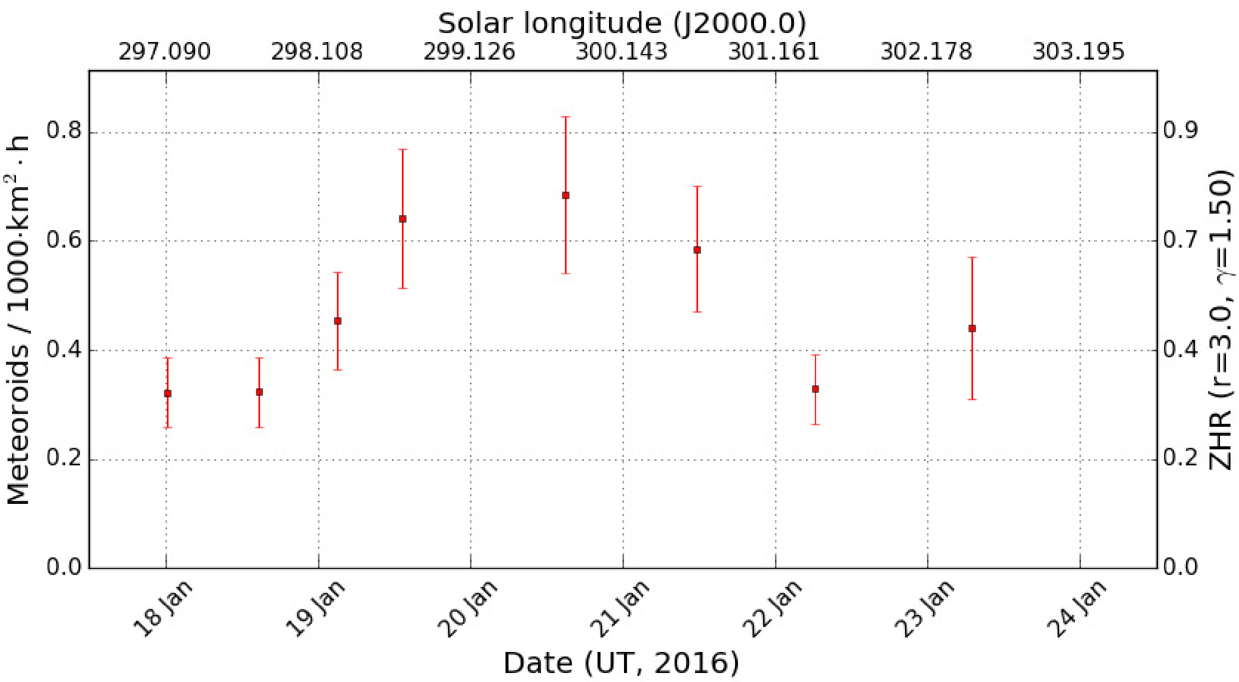

Figure 3: *Flux density profile of the gamma Ursae Minorids in January 2016, derived from observations of the IMO video network.*

Also with respect to the meteor detection software there has been progress in the past few weeks. In particular we addressed the problem that the limiting magnitude calculated by MetRec depends on the start value of the NoiseLevel parameter. This problem was described in the April report of 2015. Here we want to reiterate it briefly and present a solution.

To determine the limiting magnitude, a number of video frames are averaged and high-pass filtered to highlight point like objects. Thereafter a threshold is applied: All objects brighter than the threshold are segmented and identified according to their position in the field of view. They are either stars or false detections (noise), whereby “hot pixels” are removed first. The number of detected stars is translated into a limiting magnitude by the star field counting method. Thus, the limiting magnitude depends significantly from the segmentation threshold (the NoiseLevel): The lower the threshold, the more objects are segmented, among these more (fainter) stars which increases the calculated limiting magnitude. If the threshold is increasing, fewer objects are segmented, fewer stars identified and the limiting magnitude decreases.

Since the observing conditions vary from camera to camera, from night to night and even from hour to hour, the threshold has to be adapted dynamically to the noise level of the camera. This is done by looking at the number of false detections. Every minute the threshold is adapted by a small amount such that the observed number of false detections converges to a given target number. So far the target number was variable: If only few stars were identified, at least as many false detection should be detected. If the number of identified stars was increasing, absolutely more false detections were allowed, but their percentage relative to the total number of segmented objects was to decrease.

The analysis of April 2015 had shown that the NoiseLevel threshold would not converge to a stable value with this variable target number of false detections. If the procedure starts from a large NoiseLevel, the threshold reaches already with only few stars the target number of false detections. However, if the procedure starts with a smaller NoiseLevel, the threshold converges to a larger number of false detections which also fits to the optimization criterion. That was confirmed by a series of tests (figure 4). The same 15-minute chunk of video footage from the 2011 Draconids was processed several times with a different NoiseLevel start values. The left graph shows how the threshold evolves within a quarter of an hour, the right graph the corresponding limiting magnitude. Even after 15 minutes, the calculated limiting magnitude varied by almost half a magnitude!

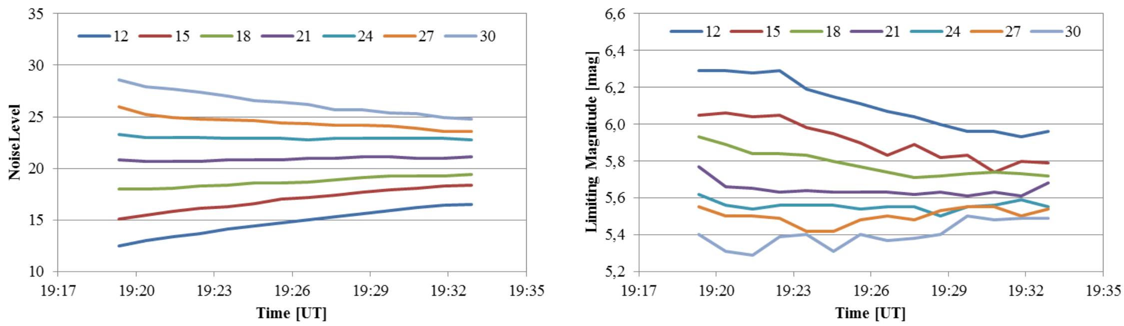

Figure 4: *Development of the NoiseLevel threshold (left) and the determined limiting magnitude (right) using the original procedure with variable target number of false detections.*

Instead of using a variable target number of false detections it was tested whether a camera-specific, but fixed target would improve the results. The target number was set equal to a predefined percentage of the overall number of active pixels in the fov to account for smaller fields of view (e.g. of image-intensified cameras). Indeed, the NoiseLevel is now converging faster at different start values (figure 4). The dispersion halved after 15 minutes, but the algorithm still did not converge to a stable solution and the limiting magnitude still varied by over 0.2 mag depending on the start value.

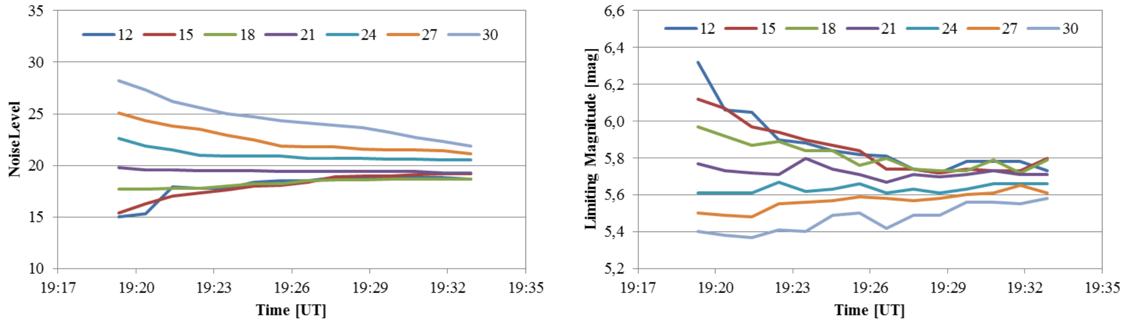

Figure 5: *Development of the NoiseLevel threshold (left) and the determined limiting magnitude (right) using the improved procedure with fixed target number of false detections.*

The reason was that the update function for the NoiseLevel threshold yields only small corrections close to the target number. That is necessary to avoid osciallations of the threshold, which have been observed for some cameras in the past.

Thus we used a trick with an asymmetric update function (figure 6): If there are more false detections than targeted, the update function remains flat as before. If there are fewer false detections, however, there will be larger, linear corrections. Even if the threshold is now overshooting, there will be no oscillations, since the backward correction is done in small steps only. Hence, the threshold is approaching the target always from one side and converging to the same value after a short amount of time.

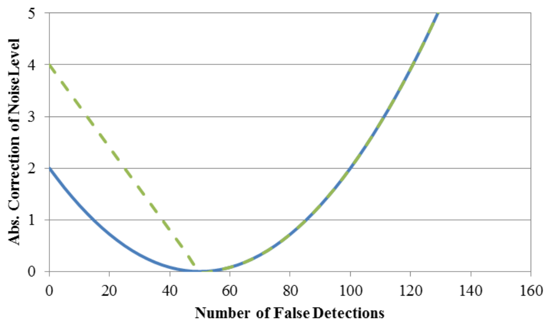

Figure 6: *Symmetric and asymmetric update function for the NoiseLevel threshold depending on the number of false detections (target value: 50).*

Figure 7 confirms that independent of the start value indeed the same NoiseLevel threshold and limiting magnitude are reached after ten minutes. The dispersion is only 0.05 mag in the end.

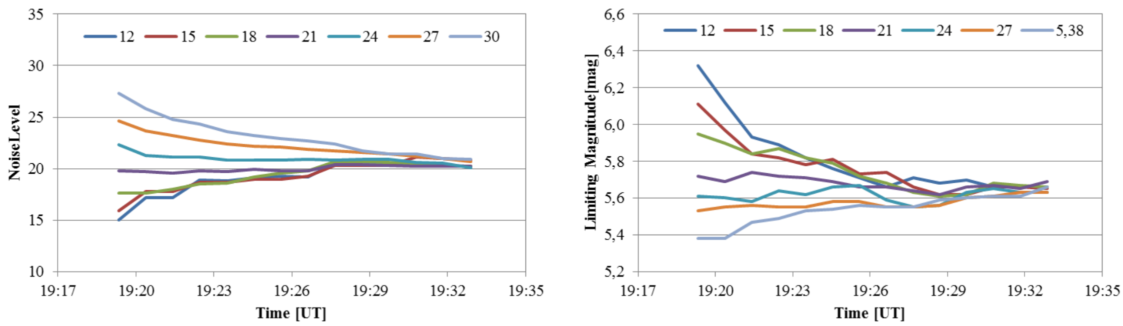

Figure 7: *Development of the NoiseLevel threshold (left) and the determined limiting magnitude (right) using the best procedure with fixed target number of false detections and asymmetric update function.*

The new software version is still tested and will be provided shortly to all observers. Once the software has been used for a few months, we can analyze new observations, re-calculate the perception coefficients of the cameras and check, if the newly determined limiting magnitudes and flux densities become indeed more consistent and less dispersed.

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	21	96.9	468
BANPE	Bánfalvi	Zalaegerszeg/HU	HUVCSE01 (0.95/5)	2423	3.4	361	13	18.1	118
BERER	Berkó	Ludanyhalaszi/HU	HULUD1 (0.8/3.8)	5542	4.8	3847	6	65.6	502
BOMMA	Bombardini	Faenza/IT	MARIO (1.2/4.0)	5794	3.3	739	22	176.9	563
BREMA	Breukers	Hengelo/NL	MBB3 (0.75/6)	2399	4.2	699	16	91.1	132
BRIBE	Klemt	Herne/DE	HERMINE (0.8/6)	2374	4.2	678	20	118.5	265
		Berg. Gladbach/DE	KLEMOI (0.8/6)	2286	4.6	1080	20	91.3	192
CASFL	Castellani	Monte Baldo/IT	BMH1 (0.8/6)	2350	5.0	1611	27	254.1	714
			BMH2 (1.5/4.5)*	4243	3.0	371	26	258.3	545
CRIST	Crivello	Valbrevenna/IT	BILBO (0.8/3.8)	5458	4.2	1772	20	154.4	517
			C3P8 (0.8/3.8)	5455	4.2	1586	16	131.1	261
			STG38 (0.8/3.8)	5614	4.4	2007	23	167.0	775
DONJE	Donati	Faenza/IT	JENNI (1.2/4)	5886	3.9	1222	24	152.6	706
ELTMA	Eltri	Venezia/IT	MET38 (0.8/3.8)	5631	4.3	2151	15	122.3	279
FORKE	Förster	Carlsfeld/DE	AKM3 (0.75/6)	2375	5.1	2154	11	59.0	156
GONRU	Goncalves	Tomar/PT	TEMPLAR1 (0.8/6)	2179	5.3	1842	17	132.1	332
			TEMPLAR2 (0.8/6)	2080	5.0	1508	17	129.1	255
			TEMPLAR3 (0.8/8)	1438	4.3	571	20	128.0	138
			TEMPLAR4 (0.8/3.8)	4475	3.0	442	17	107.3	208
			TEMPLAR5 (0.75/6)	2312	5.0	2259	22	117.1	297
GOVMI	Govedic	Sredisce ob Dr./SI	ORION2 (0.8/8)	1447	5.5	1841	18	127.8	212
			ORION3 (0.95/5)	2665	4.9	2069	20	123.9	173
			ORION4 (0.95/5)	2662	4.3	1043	20	142.9	159
HERCA	Hergenrother	Tucson/US	SALSA3 (0.8/3.8)	2336	4.1	544	30	253.1	537
HINWO	Hinz	Schwarzenberg/DE	HINWO1 (0.75/6)	2291	5.1	1819	15	90.0	224
IGAAN	Igaz	Hodmezovasar./HU	HUHOD (0.8/3.8)	5502	3.4	764	17	61.1	93
		Budapest/HU	HUPOL (1.2/4)	3790	3.3	475	8	79.0	45
JONKA	Jonas	Budapest/HU	HUSOR (0.95/4)	2286	3.9	445	10	90.5	134
			HUSOR2 (0.95/3.5)	2465	3.9	715	13	89.2	154
KACJA	Kac	Kamnik/SI	CVETKA (0.8/3.8)	4914	4.3	1842	15	138.2	487
		Ljubljana/SI	ORION1 (0.8/8)	1399	3.8	268	8	49.0	25
		Kamnik/SI	REZIKA (0.8/6)	2270	4.4	840	15	133.8	798
			STEFKA (0.8/3.8)	5471	2.8	379	15	139.1	409
KOSDE	Koschny	Izana Obs./ES	ICC7 (0.85/25)*	714	5.9	1464	29	210.0	1251
		La Palma / ES	ICC9 (0.85/25)*	683	6.7	2951	21	163.3	1838
		La Palma / ES	LIC2 (3.2/50)*	2199	6.5	7512	24	177.9	2116
		Noordwijkerhout/NL	LIC4 (1.4/50)*	2027	6.0	4509	12	42.0	63
LOJTO	Łojek	Grabniak/PL	PAV57 (1.0/5)	1631	3.5	269	8	69.5	436
LOPAL	Lopes	Lisboa/PT	NASO1 (0.75/6)	2377	3.8	506	18	114.1	91
MACMA	Maciejewski	Chelm/PL	PAV35 (0.8/3.8)	5495	4.0	1584	22	119.8	571
			PAV36 (0.8/3.8)*	5668	4.0	1573	18	104.7	423
			PAV43 (0.75/4.5)*	3132	3.1	319	12	105.3	260
			PAV60 (0.75/4.5)	2250	3.1	281	19	131.9	503
MARGR	Maravelias	Lofoupoli/GR	LOOMECON (0.8/12)	738	6.3	2698	22	91.8	393
MARRU	Marques	Lisbon/PT	RAN1 (1.4/4.5)	4405	4.0	1241	16	108.3	176
MOLSI	Molau	Seysdorf/DE	AVIS2 (1.4/50)*	1230	6.9	6152	11	61.0	288
			ESCIMO2 (0.85/25)	155	8.1	3415	14	108.1	87
			MINCAM1 (0.8/8)	1477	4.9	1084	15	76.2	164
		Ketzür/DE	REMO1 (0.8/8)	1467	6.5	5491	22	109.7	515
			REMO2 (0.8/8)	1478	6.4	4778	19	110.7	514
			REMO4 (0.8/8)	1478	6.5	5358	23	116.1	461
MORJO	Morvai	Fülöpszallas/HU	HUFUL (1.4/5)	2522	3.5	532	19	138.1	171
MOSFA	Moschini	Rovereto/IT	ROVER (1.4/4.5)	3896	4.2	1292	25	32.6	213
OTTMI	Otte	Pearl City/US	ORIE1 (1.4/5.7)	3837	3.8	460	22	186.6	250
PERZS	Perkó	Becsehely/HU	HUBEC (0.8/3.8)*	5498	2.9	460	23	165.2	548
ROTEC	Rothenberg	Berlin/DE	ARMEFA (0.8/6)	2366	4.5	911	2	13.7	60
SARAN	Saraiva	Carnaxide/PT	RO1 (0.75/6)	2362	3.7	381	15	95.4	158
			RO2 (0.75/6)	2381	3.8	459	15	100.8	162
			RO3 (0.8/12)	710	5.2	619	16	110.2	208
			SOFIA (0.8/12)	738	5.3	907	17	121.5	167
SCALE	Scarpa	Alberoni/IT	LEO (1.2/4.5)*	4152	4.5	2052	21	157.8	158
SCHHA	Schremmer	Niederkrüchten/DE	DORAEMON (0.8/3.8)	4900	3.0	409	18	112.9	247
SLAST	Slavec	Ljubljana/SI	KAYAK1 (1.8/28)	563	6.2	1294	15	135.3	217
			KAYAK2 (0.8/12)	741	5.5	920	12	136.5	113
STOEN	Stomeo	Scorze/IT	MIN38 (0.8/3.8)	5566	4.8	3270	25	179.3	703
			NOA38 (0.8/3.8)	5609	4.2	1911	25	194.2	606
			SCO38 (0.8/3.8)	5598	4.8	3306	25	209.4	802
STRJO	Strunk	Herford/DE	MINCAM2 (0.8/6)	2354	5.4	2751	17	91.8	356
			MINCAM3 (0.8/6)	2338	5.5	3590	16	95.4	234
			MINCAM4 (1.0/2.6)	9791	2.7	552	12	23.3	72
			MINCAM5 (0.8/6)	2349	5.0	1896	13	94.8	200
			MINCAM6 (0.8/6)	2395	5.1	2178	13	89.9	174
TEPIS	Tepliczky	Agostyan/HU	HUAGO (0.75/4.5)	2427	4.4	1036	17	138.6	226
			HUMOB (0.8/6)	2388	4.8	1607	16	108.8	285
TRIMI	Triglav	Velenje/SI	SRAKA (0.8/6)*	2222	4.0	546	18	76.7	221
YRJIL	Yrjölä	Kuusankoski/FI	FINEXCAM (0.8/6)	2337	5.5	3574	20	170.1	395
Sum							31	9087.7	27969

* active field of view smaller than video frame

2. Observing Times (h)

January	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15
ARLRA	-	-	6.6	3.4	-	-	0.4	7.2	8.6	3.8	-	2.2	-	6.0	-
BANPE	-	-	-	-	-	-	-	-	-	-	-	0.2	0.4	-	2.2
BERER	10.7	-	13.0	-	-	-	4.8	-	-	-	-	-	-	-	-
BOMMA	4.5	-	1.3	-	-	13.5	0.8	0.8	-	-	12.2	9.4	10.6	-	6.3
BREMA	5.8	-	-	-	-	-	5.4	10.8	4.1	4.6	0.8	1.0	10.0	-	4.4
BRIBE	4.1	0.8	1.1	2.0	-	1.9	8.3	12.9	7.0	7.4	-	-	10.6	-	3.1
	0.4	-	-	0.2	-	0.6	7.6	10.5	4.6	5.4	-	0.7	9.5	0.7	0.4
CASFL	12.1	0.4	-	9.9	11.1	13.5	13.5	-	5.7	-	11.8	-	10.9	6.9	12.1
	11.5	-	-	10.0	10.6	13.3	13.3	-	4.8	-	11.3	-	9.4	5.7	10.4
CRIST	-	2.3	0.9	1.8	2.0	11.8	7.5	-	0.7	-	12.6	11.8	9.9	8.9	12.9
	-	-	-	-	3.4	8.5	7.3	-	-	-	11.8	9.8	9.9	7.7	12.4
	-	3.3	1.6	4.5	2.5	12.6	8.1	-	0.7	0.2	12.5	13.0	11.3	10.3	12.9
DONJE	5.9	-	1.8	-	-	13.4	0.7	1.2	1.1	9.0	12.1	9.3	-	-	-
ELTMA	3.6	-	-	5.0	-	10.3	-	-	-	-	9.6	6.1	5.6	-	-
FORKE	12.5	-	0.9	-	-	-	-	12.9	-	-	-	1.3	0.5	-	-
GONRU	10.1	-	-	5.3	6.5	-	-	-	-	-	9.4	10.3	5.0	-	12.4
	9.0	-	-	5.2	6.1	-	-	-	-	-	9.3	9.7	4.2	-	12.7
	8.5	-	-	4.7	3.6	-	-	5.3	-	-	11.5	8.9	2.8	2.8	12.5
	6.7	0.2	-	3.8	4.8	-	-	-	-	-	7.8	8.2	1.9	-	12.6
	6.4	0.5	-	4.2	3.9	-	-	4.1	-	-	11.3	8.0	3.4	3.1	12.4
GOVMI	10.6	-	-	3.2	-	-	-	-	-	2.1	0.3	7.9	-	-	6.7
	10.6	-	-	-	-	-	-	-	-	1.6	0.2	5.2	9.9	2.1	-
	10.8	-	-	3.0	-	-	-	-	-	1.9	-	5.7	7.4	-	3.9
HERCA	6.5	11.9	11.9	3.8	2.5	-	4.3	2.0	1.8	10.7	6.8	11.7	11.6	11.6	11.0
HINWO	7.1	-	1.2	-	-	1.8	-	13.5	8.4	-	1.4	3.5	3.7	-	-
IGAAN	1.2	-	2.7	-	-	-	2.6	-	-	0.3	-	6.3	6.3	0.8	6.3
	-	-	-	-	-	-	-	-	-	-	-	8.1	8.8	-	8.8
JONKA	-	-	11.7	-	-	-	6.8	-	-	-	-	-	5.5	4.1	12.6
	0.5	-	11.1	-	-	-	5.9	-	-	-	-	2.5	5.5	3.9	10.3
KACJA	13.3	-	-	-	-	-	-	-	-	-	-	6.6	5.6	-	2.3
	11.3	-	-	-	-	-	-	-	-	-	-	7.0	-	-	-
	13.7	-	-	-	-	-	-	-	-	-	-	7.1	12.5	-	3.3
	13.3	-	-	-	-	-	-	-	-	-	-	7.2	6.6	-	2.0
KOSDE	10.7	11.3	11.3	-	9.7	10.6	11.3	3.5	10.4	9.3	10.6	9.8	5.7	2.8	3.1
	-	8.5	9.1	10.0	11.1	11.2	-	1.4	11.2	11.2	10.9	11.2	3.5	-	-
	11.3	11.3	9.5	11.3	11.3	11.3	-	1.6	10.6	11.2	-	11.2	3.8	-	0.4
	-	-	-	0.7	-	-	4.3	8.0	-	2.2	-	1.1	-	-	1.1
LOJTO	4.8	12.2	13.3	12.3	-	-	-	-	-	-	-	-	-	-	-
LOPAL	3.1	-	-	3.5	5.2	-	-	4.9	-	-	10.8	11.0	-	0.3	12.6
MACMA	8.7	3.0	10.9	5.3	0.3	0.8	-	1.3	12.1	-	-	-	0.4	4.7	-
	8.7	-	13.7	5.8	3.5	-	-	1.0	11.0	-	-	-	-	3.1	-
	8.7	-	13.7	7.0	-	-	-	-	13.3	-	-	-	13.0	4.5	-
	8.6	3.8	13.9	6.7	3.8	1.3	-	1.0	12.7	-	-	-	-	4.6	-
MARGR	1.4	3.1	-	0.2	3.7	0.3	3.4	3.3	0.8	3.6	3.2	4.3	9.8	8.4	8.3
MARRU	1.7	-	-	2.8	5.5	-	-	-	-	-	9.5	11.3	2.4	-	11.9
MOLSI	-	-	-	11.0	9.1	-	8.5	-	3.8	-	4.1	7.5	8.0	-	-
	-	-	-	11.7	8.9	-	8.3	-	-	-	-	8.1	7.3	-	-
	-	-	-	9.8	6.5	-	6.5	-	0.5	-	2.1	6.2	6.6	-	-
	-	-	4.6	4.2	-	-	0.4	8.5	9.1	5.2	-	3.0	2.5	4.7	-
	-	-	4.5	4.9	-	-	-	9.3	9.3	6.6	-	4.1	3.4	5.9	-
	-	-	4.7	4.9	0.3	-	0.6	8.9	9.5	6.4	-	2.9	3.0	4.2	-
MORJO	0.5	-	11.3	0.8	-	-	4.4	-	-	2.8	-	8.1	7.9	4.1	13.3
MOSFA	0.3	0.2	-	0.2	1.9	2.1	2.8	0.2	-	-	1.2	2.3	2.4	1.3	1.8
OTTMI	13.0	11.2	4.0	13.0	13.0	-	-	-	1.5	12.9	4.0	11.6	8.0	12.1	3.7
PERZS	7.5	-	1.3	2.8	-	-	4.9	-	-	4.2	-	10.5	10.6	-	10.7
ROTEC	-	1.8	11.9	-	-	-	-	-	-	-	-	-	-	-	-
SARAN	3.6	-	-	-	6.7	-	-	3.5	-	-	-	12.5	2.7	2.3	12.6
	2.5	-	-	-	3.8	-	-	2.8	-	-	10.2	12.5	2.0	1.2	12.5
	3.8	-	-	-	5.5	-	-	3.5	-	-	11.0	-	2.5	1.9	12.3
	4.1	-	-	-	6.7	-	-	3.7	-	-	11.2	11.9	4.4	2.1	11.1
SCALE	9.2	-	4.9	-	2.9	9.3	3.5	-	-	-	10.2	3.8	5.9	3.1	8.1
SCHHA	1.5	-	-	4.3	-	3.5	10.7	11.8	5.1	9.6	-	1.5	10.4	-	2.8
SLAST	12.2	-	-	-	-	-	-	-	-	-	-	8.9	3.8	-	-
	12.7	-	-	-	-	-	-	-	-	-	-	9.6	-	-	-
STOEN	10.9	-	1.1	2.1	2.3	11.1	11.3	-	1.5	-	12.0	7.2	8.1	4.0	8.6
	10.2	-	1.4	2.5	2.7	11.8	11.2	-	2.0	-	12.3	7.6	7.4	4.2	7.7
	12.5	-	0.8	2.3	3.1	12.0	12.1	-	2.5	-	12.5	7.8	7.3	3.9	11.6
STRJO	5.6	-	0.2	-	-	-	3.7	10.7	8.8	0.4	-	0.4	7.0	0.5	-
	5.6	0.3	-	-	-	-	3.2	10.5	9.1	-	-	0.6	6.3	0.6	-
	1.5	-	-	-	-	-	-	-	2.7	0.2	-	0.2	0.3	-	-
	5.6	-	-	-	-	-	4.9	10.9	9.1	-	-	-	6.5	0.5	-
	3.8	-	-	-	-	-	3.5	10.5	8.5	0.3	-	-	6.3	-	-
TEPIS	-	-	10.9	-	-	-	5.7	-	-	5.3	-	7.3	8.7	-	3.1
	-	-	4.9	-	-	-	3.5	-	-	2.3	-	6.7	7.0	1.7	7.2
TRIMI	4.6	-	-	8.2	-	3.1	5.7	-	-	-	-	2.8	5.4	-	5.1
YRJIL	7.9	-	4.0	11.6	14.4	14.7	14.8	3.8	8.7	7.1	2.3	-	6.4	7.7	10.6
Sum	417.5	86.1	231.7	229.9	198.9	204.3	246.5	205.8	221.3	147.8	290.8	414.2	406.0	169.0	387.1

January	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
ARLRA	1.7	11.8	-	1.7	11.6	4.6	-	1.7	1.7	3.3	3.1	10.2	0.7	5.4	1.2	1.7
BANPE	2.9	3.3	-	0.6	1.0	1.9	-	0.5	-	-	0.7	0.5	2.2	-	-	2.9
BERER	-	12.2	-	-	13.1	11.8	-	-	-	-	-	-	-	-	-	-
BOMMA	8.3	5.5	13.2	8.2	-	8.4	12.2	11.0	12.8	11.4	-	11.8	-	2.5	1.7	8.3
BREMA	12.8	11.7	0.9	4.2	-	-	-	-	-	-	-	6.6	-	4.6	-	12.8
BRIBE	12.2	10.9	-	1.4	11.7	-	-	-	3.0	0.9	-	9.3	-	3.7	-	12.2
	-	11.7	3.0	-	12.2	-	0.3	-	2.3	1.6	-	10.2	-	3.7	-	-
CASFL	13.2	11.4	8.7	13.1	8.2	3.4	12.9	10.4	12.9	12.1	3.7	1.7	7.1	2.0	12.2	13.2
	12.9	9.2	9.1	13.0	7.9	5.9	12.9	11.2	12.8	12.8	10.1	8.1	6.8	1.9	10.6	12.9
CRIST	12.8	-	2.1	5.7	10.8	-	11.1	3.5	-	-	-	-	-	-	12.4	12.8
	12.8	-	0.4	3.8	11.8	-	12.7	2.4	-	-	-	-	-	-	3.5	12.8
	12.8	-	3.9	6.9	9.5	1.2	9.9	3.7	-	-	-	-	0.3	-	12.4	12.8
DONJE	8.8	6.5	11.0	8.1	1.3	4.1	7.3	6.0	9.5	9.6	0.3	11.2	-	3.1	1.9	8.8
ELTMA	11.9	12.8	6.9	11.2	-	6.0	6.2	-	8.3	5.8	-	-	-	-	-	11.9
FORKE	-	9.2	2.0	-	7.4	6.3	-	-	4.6	-	-	-	1.4	-	-	-
GONRU	-	4.2	-	-	-	-	8.1	5.7	3.2	3.5	-	11.6	11.6	4.6	11.3	-
	-	3.6	-	-	-	-	10.0	5.5	2.5	2.6	-	11.4	12.2	4.5	11.3	-
	1.3	3.1	-	-	-	-	10.2	-	4.0	3.7	0.5	11.0	11.8	3.5	10.4	1.3
	-	1.5	-	-	-	-	7.8	5.4	-	2.7	-	11.7	11.2	2.3	10.7	-
	1.3	2.8	1.1	-	-	0.2	7.0	-	2.0	2.4	-	10.6	11.5	2.3	10.4	1.3
GOVMI	13.0	12.9	8.4	4.8	2.2	-	1.8	-	5.7	9.5	-	11.6	10.3	5.4	-	13.0
	12.3	12.9	5.1	3.2	-	6.8	-	3.7	4.1	7.5	7.1	8.4	9.1	4.1	0.2	12.3
	13.0	12.7	5.6	4.6	1.8	10.5	-	3.8	4.7	9.4	9.8	9.8	9.3	3.8	-	13.0
HERCA	5.1	10.5	7.4	6.7	10.7	8.4	6.7	3.7	9.8	8.2	11.4	11.5	11.5	11.3	11.5	5.1
HINWO	-	10.9	5.0	-	13.0	5.2	-	-	-	-	-	10.5	-	3.5	-	-
IGAAN	2.8	3.9	3.8	1.0	-	7.1	-	-	-	-	4.1	5.8	5.7	0.4	-	2.8
	12.8	11.7	-	-	12.5	9.3	-	-	-	-	-	-	-	-	-	12.8
JONKA	8.2	13.2	-	-	13.1	13.0	-	-	-	-	-	-	-	-	-	8.2
	8.8	13.2	-	1.0	12.2	11.8	-	-	-	-	-	-	-	-	-	8.8
KACJA	10.3	12.2	10.0	11.7	-	10.8	11.3	-	6.8	12.8	-	2.5	9.0	-	-	10.3
	2.6	-	-	-	-	-	5.8	-	7.2	12.4	-	1.7	-	-	-	2.6
	10.3	12.1	9.4	9.7	-	6.0	7.9	-	5.7	12.9	-	2.5	9.0	-	-	10.3
	10.3	12.2	9.2	10.6	-	10.1	12.6	-	7.5	12.9	-	2.5	9.1	-	-	10.3
KOSDE	3.0	4.5	5.8	7.5	2.3	1.7	5.2	7.4	7.6	9.3	-	5.0	8.5	9.6	5.7	3.0
	7.9	9.1	8.1	7.0	-	-	-	-	5.5	5.5	-	6.0	2.9	6.5	-	7.9
	8.0	9.1	8.0	7.1	2.8	0.9	3.8	7.5	11.0	-	-	6.3	3.2	-	-	8.0
	7.5	3.7	-	5.1	3.2	-	-	-	-	-	1.8	-	-	-	-	7.5
LOJTO	-	-	-	-	-	6.9	4.0	-	-	-	-	8.6	-	-	-	-
LOPAL	2.4	-	1.6	-	-	-	4.2	4.3	10.9	5.5	-	5.9	11.9	-	6.5	2.4
MACMA	0.2	4.2	9.1	-	6.5	3.1	4.5	-	-	-	1.6	12.8	4.4	8.1	8.1	0.2
	-	3.4	10.3	-	2.0	2.5	7.2	-	-	-	1.6	12.5	3.5	7.3	7.4	-
	-	-	-	-	-	-	-	-	-	-	1.7	13.0	4.2	8.1	8.0	-
	-	4.1	11.7	-	5.2	-	9.2	-	-	-	1.6	13.0	4.5	7.5	8.3	-
MARGR	-	-	-	-	0.7	-	-	-	0.2	-	8.6	9.6	1.9	7.9	8.9	-
MARRU	3.0	-	2.1	-	-	-	4.9	-	10.8	3.6	-	9.7	12.1	-	8.6	3.0
MOLSI	4.4	0.4	2.8	-	-	-	-	-	-	-	-	-	-	-	-	4.4
	5.9	-	3.7	-	8.2	4.4	6.4	-	10.7	10.5	1.5	-	12.5	-	-	5.9
	2.8	-	2.2	-	-	3.7	1.7	-	7.9	8.4	-	-	10.4	-	-	2.8
	3.4	13.2	-	2.6	12.7	6.2	-	0.9	4.4	3.1	1.4	10.9	-	5.4	1.7	3.4
	3.6	12.6	-	2.3	12.5	5.2	-	-	2.9	3.3	-	10.7	-	4.9	1.9	3.6
	3.6	13.6	0.7	3.7	12.6	6.0	-	-	4.2	3.3	2.4	10.9	-	6.4	1.4	3.6
MORJO	10.8	13.2	3.8	-	12.9	13.0	-	1.5	-	-	4.7	10.9	12.4	1.7	-	10.8
MOSFA	2.4	1.8	1.7	1.8	0.5	-	0.9	1.6	1.0	1.2	0.3	-	0.2	0.3	-	2.4
OTTMI	12.8	12.8	-	0.3	-	6.5	6.3	-	-	-	11.4	7.2	8.9	0.4	12.0	12.8
PERZS	10.9	11.0	7.5	4.2	4.6	7.6	2.9	0.3	3.6	11.0	8.3	11.3	12.7	5.0	-	10.9
ROTEC	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SARAN	1.9	-	-	-	-	-	6.0	-	9.1	1.3	-	8.0	11.6	-	6.5	1.9
	1.5	-	-	-	-	-	-	-	11.4	5.3	-	7.0	12.4	-	6.6	1.5
	2.5	-	-	-	-	-	7.5	4.0	10.6	7.2	-	9.9	12.1	-	6.5	2.5
	2.2	-	-	-	-	-	7.5	3.9	12.2	3.4	-	9.6	11.8	-	6.7	2.2
SCALE	12.8	12.4	5.1	8.8	-	5.6	8.7	6.6	8.8	9.6	-	-	6.3	-	-	12.8
SCHHA	13.2	-	-	0.8	11.7	-	-	-	2.2	-	1.5	10.0	-	3.8	-	13.2
SLAST	12.8	12.7	11.9	10.2	-	9.7	7.6	-	5.9	12.5	1.3	5.5	7.5	-	-	12.8
	12.2	13.1	12.6	10.7	-	-	11.1	-	12.9	13.0	-	8.7	7.6	-	-	12.2
STOEN	11.5	10.5	3.6	8.7	-	3.4	9.2	7.9	12.8	10.5	2.1	5.5	0.2	-	-	11.5
	11.7	13.2	5.4	11.9	2.7	4.7	9.1	8.8	12.0	11.4	2.0	7.2	-	-	-	11.7
	12.4	13.3	7.6	13.1	2.3	3.8	13.0	10.8	12.9	12.7	-	4.7	-	-	1.1	12.4
STRJO	10.3	9.4	-	5.4	7.8	0.7	-	-	3.2	-	-	9.6	-	8.1	-	10.3
	9.8	9.2	-	6.4	13.1	-	-	-	2.7	-	-	9.0	-	8.0	-	9.8
	2.8	4.7	0.5	-	7.5	-	-	-	-	-	-	1.3	-	1.1	-	2.8
	10.5	10.0	-	6.2	11.7	-	-	-	3.3	-	-	7.6	-	8.0	-	10.5
	9.6	11.0	-	5.3	9.6	-	-	-	3.1	-	-	10.1	-	8.3	-	9.6
TEPIS	12.1	11.5	3.7	-	12.9	12.9	-	6.2	-	12.8	1.8	3.0	12.6	-	-	12.1
	12.2	11.2	3.0	-	12.4	12.7	-	-	-	-	-	1.0	12.6	4.7	-	12.2
TRIMI	3.8	4.2	3.0	-	-	1.4	4.5	-	4.6	4.7	-	1.3	3.7	-	4.9	3.8
YRJIL	14.0	-	13.4	4.1	9.9	-	-	-	-	-	-	-	2.4	5.1	-	14.0
Sum	507.6	532.9	275.1	264.4	360.3	275.4	320.1	149.9	339.5	327.1	106.4	476.0	364.8	198.8	232.5	507.6

3. Results (Meteors)

January	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15
ARLRA	-	-	51	3	-	-	2	75	52	12	-	8	-	7	-
BANPE	-	-	-	-	-	-	-	-	-	-	-	1	3	-	15
BERER	49	-	322	-	-	-	12	-	-	-	-	-	-	-	-
BOMMA	4	-	3	-	-	71	5	4	-	-	54	34	38	-	7
BREMA	10	-	-	-	-	-	15	12	4	8	2	2	12	-	8
BRIBE	6	2	1	2	-	1	23	30	16	33	-	-	25	-	8
	1	-	-	1	-	2	25	17	6	22	-	1	23	2	1
CASFL	25	2	-	24	33	60	48	-	13	-	51	-	41	31	33
	18	-	-	24	33	44	38	-	11	-	30	-	22	27	28
CRIST	-	14	2	1	4	37	23	-	2	-	47	64	21	23	46
	-	-	-	-	8	18	11	-	-	-	25	28	5	32	20
	-	35	2	8	4	48	33	-	4	1	70	76	23	47	77
DONJE	10	-	4	-	-	90	4	6	7	33	68	49	-	-	-
ELTMA	10	-	-	5	-	23	-	-	-	-	41	9	6	-	-
FORKE	29	-	3	-	-	-	-	50	-	-	-	1	5	-	-
GONRU	18	-	-	27	15	-	-	-	-	-	24	13	6	-	47
	17	-	-	21	8	-	-	-	-	-	18	9	4	-	41
	5	-	-	8	2	-	-	8	-	-	17	7	2	11	15
	6	1	-	23	8	-	-	-	-	-	12	8	3	-	17
	13	1	-	24	11	-	-	23	-	-	21	9	4	12	43
GOVMI	13	-	-	6	-	-	-	-	-	5	1	6	-	-	12
	10	-	-	-	-	-	-	-	-	3	1	7	13	3	-
	10	-	-	2	-	-	-	-	-	2	-	2	9	-	6
HERCA	19	28	32	7	4	-	1	2	1	22	33	38	23	20	20
HINWO	29	-	3	-	-	4	-	44	16	-	3	3	5	-	-
IGAAN	4	-	11	-	-	-	1	-	-	1	-	9	13	1	8
	-	-	-	-	-	-	-	-	-	-	-	7	10	-	2
JONKA	-	-	49	-	-	-	2	-	-	-	-	-	11	1	8
	2	-	54	-	-	-	5	-	-	-	-	8	8	1	15
KACJA	59	-	-	-	-	-	-	-	-	-	-	9	19	-	4
	8	-	-	-	-	-	-	-	-	-	-	4	-	-	-
	93	-	-	-	-	-	-	-	-	-	-	18	79	-	13
	47	-	-	-	-	-	-	-	-	-	-	12	47	-	3
KOSDE	84	77	129	-	60	85	67	21	86	75	57	68	27	15	17
	-	66	85	107	108	138	-	19	157	149	80	115	47	-	-
	134	136	153	165	160	151	-	12	153	157	-	123	47	-	1
	-	-	-	2	-	-	14	13	-	3	-	2	-	-	2
LOJTO	32	57	226	34	-	-	-	-	-	-	-	-	-	-	-
LOPAL	3	-	-	3	4	-	-	8	-	-	5	2	-	1	11
MACMA	65	7	223	21	1	1	-	4	31	-	-	-	1	25	-
	41	-	232	16	2	-	-	1	18	-	-	-	-	13	-
	23	-	139	9	-	-	-	-	21	-	-	-	1	7	-
	46	4	223	19	2	1	-	1	27	-	-	-	-	17	-
MARGR	7	24	-	1	31	2	28	25	5	30	32	32	31	30	27
MARRU	3	-	-	8	12	-	-	-	-	-	14	7	4	-	19
MOLSI	-	-	-	61	28	-	63	-	9	-	10	26	61	-	-
	-	-	-	12	9	-	6	-	-	-	-	4	4	-	-
	-	-	-	17	17	-	22	-	3	-	2	7	17	-	-
	-	-	41	2	-	-	4	81	38	10	-	6	11	5	-
	-	-	46	2	-	-	-	96	56	23	-	16	13	7	-
	-	-	47	7	1	-	1	95	35	15	-	11	15	5	-
MORJO	1	-	42	2	-	-	2	-	-	4	-	13	10	2	13
MOSFA	2	1	-	1	12	10	17	1	-	-	8	15	21	9	13
OTTMI	18	19	23	19	13	-	-	-	2	13	7	13	2	13	3
PERZS	31	-	1	4	-	-	20	-	-	6	-	39	22	-	29
ROTEC	-	1	59	-	-	-	-	-	-	-	-	-	-	-	-
SARAN	5	-	-	-	13	-	-	11	-	-	-	10	4	3	18
	4	-	-	-	9	-	-	10	-	-	19	7	1	1	25
	3	-	-	-	10	-	-	14	-	-	15	-	1	4	30
	7	-	-	-	10	-	-	13	-	-	17	8	4	5	16
SCALE	4	-	2	-	7	6	12	-	-	-	10	1	3	7	13
SCHHA	3	-	-	11	-	4	40	33	6	30	-	4	19	-	12
SLAST	20	-	-	-	-	-	-	-	-	-	-	5	4	-	-
	12	-	-	-	-	-	-	-	-	-	-	4	-	-	-
STOEN	34	-	2	3	6	49	39	-	14	-	74	29	25	29	37
	19	-	2	2	8	44	50	-	11	-	67	15	23	31	26
	23	-	2	3	16	56	57	-	14	-	67	27	25	35	44
STRJO	7	-	1	-	-	-	16	57	26	2	-	1	28	1	-
	10	2	-	-	-	-	8	41	16	-	-	1	14	1	-
	2	-	-	-	-	-	-	-	8	1	-	1	2	-	-
	10	-	-	-	-	-	14	40	16	-	-	-	17	2	-
	3	-	-	-	-	-	8	36	14	2	-	-	10	-	-
TEPIS	-	-	48	-	-	-	3	-	-	7	-	11	23	-	3
	-	-	46	-	-	-	12	-	-	3	-	21	24	2	13
TRIMI	13	-	-	26	-	8	22	-	-	-	-	7	16	-	14
YRJIL	12	-	64	43	29	34	38	3	28	10	2	-	4	10	13
Sum	1196	477	2373	786	698	987	811	906	926	682	1004	1093	1061	498	896

January	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
ARLRA	-	7	71	-	1	68	7	-	3	1	4	3	50	3	38	2
BANPE	10	19	22	-	4	6	13	-	3	-	-	5	3	14	-	-
BERER	-	-	37	-	-	47	35	-	-	-	-	-	-	-	-	-
BOMMA	42	35	43	31	28	-	10	18	22	41	40	-	22	-	7	4
BREMA	4	23	20	2	1	-	-	-	-	-	-	-	3	-	6	-
BRIBE	8	31	25	-	1	27	-	-	-	1	1	-	17	-	7	-
	6	-	25	1	-	23	-	1	-	1	1	-	26	-	7	-
CASFL	41	48	26	12	42	11	6	31	20	29	34	7	5	18	4	19
	33	34	24	13	26	10	4	21	20	23	19	13	5	12	2	11
CRIST	59	54	-	1	36	28	-	26	4	-	-	-	-	-	-	25
	30	36	-	1	5	17	-	22	1	-	-	-	-	-	-	2
	77	87	-	5	43	55	2	41	4	-	-	-	-	1	-	32
DONJE	57	42	55	50	40	8	12	33	24	46	42	1	17	-	4	4
ELTMA	44	34	36	11	34	-	4	7	-	8	7	-	-	-	-	-
FORKE	-	-	13	1	-	40	4	-	-	9	-	-	-	1	-	-
GONRU	14	-	3	-	-	-	-	25	3	6	4	-	46	42	9	30
	10	-	3	-	-	-	-	24	2	1	4	-	32	24	15	22
	5	1	2	-	-	-	-	11	-	4	2	1	12	13	4	8
	12	-	3	-	-	-	-	14	3	-	1	-	31	43	6	17
	6	3	3	7	-	-	1	31	-	5	2	-	34	15	3	26
GOVMI	38	28	25	6	8	2	-	3	-	10	25	-	7	11	6	-
	27	21	15	8	5	-	6	-	1	4	16	13	4	11	4	1
	17	26	15	15	4	1	8	-	1	5	13	10	5	6	2	-
HERCA	26	10	24	15	19	27	13	17	21	17	5	22	16	21	19	15
HINWO	3	-	37	1	-	30	11	-	-	-	-	-	24	-	11	-
IGAAN	-	3	3	10	2	-	5	-	-	-	-	3	10	7	2	-
	5	11	1	-	-	7	2	-	-	-	-	-	-	-	-	-
JONKA	4	16	19	-	-	14	10	-	-	-	-	-	-	-	-	-
	8	11	17	-	1	14	10	-	-	-	-	-	-	-	-	-
KACJA	76	71	30	32	47	-	24	16	-	32	57	-	1	10	-	-
	1	1	-	-	-	-	-	2	-	3	5	-	1	-	-	-
	92	107	62	39	84	-	25	39	-	51	77	-	2	17	-	-
	41	51	23	21	42	-	17	29	-	21	38	-	1	16	-	-
KOSDE	40	9	43	36	8	9	6	12	1	34	49	-	19	57	51	9
	62	127	124	118	106	-	-	-	-	73	47	-	45	20	45	-
	59	131	113	84	99	19	7	10	50	73	-	-	58	21	-	-
	3	6	2	-	6	4	-	-	-	-	-	6	-	-	-	-
LOJTO	43	-	-	-	-	-	14	4	-	-	-	-	26	-	-	-
LOPAL	6	5	-	5	-	-	-	3	1	12	2	-	6	8	-	6
MACMA	15	1	7	32	-	13	19	7	-	-	-	4	56	8	6	24
	1	-	7	22	-	5	10	4	-	-	-	4	25	7	3	12
	15	-	-	-	-	-	-	-	-	-	-	7	19	5	1	13
	20	-	6	33	-	6	-	5	-	-	-	9	44	10	10	20
MARGR	1	-	-	-	-	4	-	-	-	1	-	21	33	3	11	14
MARRU	8	12	-	8	-	-	-	12	-	12	4	-	19	17	-	17
MOLSI	2	9	1	18	-	-	-	-	-	-	-	-	-	-	-	-
	-	3	-	9	-	8	3	2	-	8	10	1	-	8	-	-
	1	9	-	12	-	-	3	3	-	14	19	-	-	18	-	-
	1	43	74	-	4	71	12	-	1	15	2	3	59	-	30	2
	1	21	82	-	2	59	6	-	-	2	2	-	49	-	29	2
	1	17	65	1	5	51	15	-	-	7	3	2	34	-	26	2
MORJO	-	10	18	7	-	18	11	-	1	-	-	2	7	7	1	-
MOSFA	14	17	15	6	11	3	-	7	11	6	8	2	-	1	2	-
OTTMI	-	22	19	-	1	-	7	3	-	-	-	23	15	5	1	9
PERZS	52	61	54	31	15	15	38	16	1	19	27	11	22	32	2	-
ROTEC	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SARAN	8	11	-	-	-	-	-	15	-	9	2	-	12	16	-	21
	12	7	-	-	-	-	-	-	-	16	5	-	12	21	-	13
	9	13	-	-	-	-	-	10	1	27	4	-	17	27	-	23
	9	7	-	-	-	-	-	8	1	12	3	-	9	19	-	19
SCALE	21	22	17	5	9	-	1	3	1	7	4	-	-	3	-	-
SCHHA	22	23	-	-	1	16	-	-	-	2	-	8	12	-	1	-
SLAST	47	56	18	8	17	-	7	8	-	12	6	1	5	3	-	-
	15	13	13	9	15	-	-	6	-	8	11	-	5	2	-	-
STOEN	70	70	52	13	56	-	6	24	14	25	23	2	6	1	-	-
	56	60	54	11	42	1	3	24	16	19	17	1	4	-	-	-
	68	71	56	21	58	2	5	36	37	30	41	-	5	-	-	3
STRJO	-	39	49	-	22	30	1	-	-	6	-	-	32	-	38	-
	1	22	36	-	20	16	-	-	-	7	-	-	13	-	26	-
	3	3	22	3	-	16	-	-	-	-	-	-	4	-	7	-
	-	20	27	-	16	13	-	-	-	2	-	-	9	-	14	-
	-	15	31	-	15	8	-	-	-	1	-	-	15	-	16	-
TEPIS	15	26	3	2	-	28	21	-	3	-	13	3	1	16	-	-
	22	34	6	5	-	40	28	-	-	-	-	-	2	23	4	-
TRIMI	15	13	12	7	-	-	5	13	-	6	14	-	4	11	-	15
YRJIL	7	31	-	29	3	20	-	-	-	-	-	-	-	6	9	-
Sum	1541	1869	1708	817	1004	910	457	646	271	783	713	188	1077	660	489	442