Results of the IMO Video Meteor Network – May 2017

Sirko Molau, Abenstalstr. 13b, 84072 Seysdorf *2017/11/23*

The weather in May showed two different faces. Whereas in the first half we see large gaps in the observing statistics with down to 60 observing hours on May 11/12, the weather improved significantly in the second half of May with over 300 hours in many nights. The 77 active video cameras obtained alltogether more than 7,300 hours of effective observing time, which matches well to the outcome of the previous three years. However, since the average meteor rate was slightly lower than before (2.2 meteors per hour), also the total meteor count fell a few percent short of the previous outcome.

In early May, the eta Aquariids reach their broad maximum. Since the shower can only be observed briefly and at a low radiant altitude at European observing sites, it is difficult to obtain a complete activity profile for that shower from IMO network data. Figure 1 compares the flux density of 2017 with the average of the years 2011 till 2016 (without 2013, when the activity was significantly enhanced). Between 44° and 45° solar longitude (May 4-6) the 2017 activity was somewhat higher, otherwise it matched well to the long-term average. The peak flux density of almost 50 meteoroids per 1,000 km^2 and hour in these nights, which corresponds to a ZHR of about 100, is remarkable.

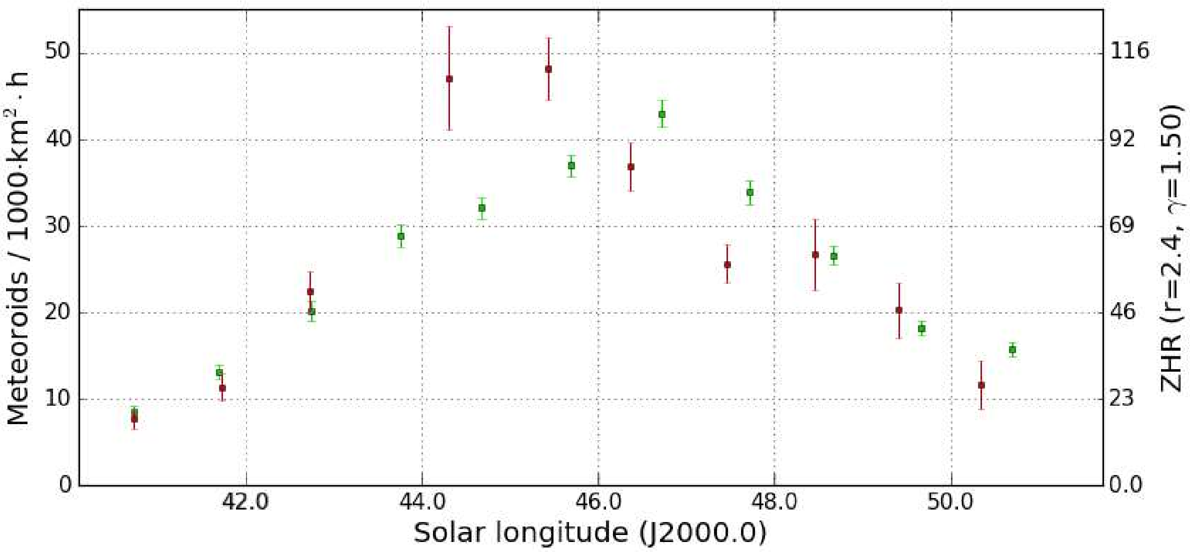

Figure 1: *Comparison of the eta Aquariid flux density 2017 (red) with the average flux density profile in the years 2011-2016 (green, without 2013), derived from video data of the IMO Network.*

To get a reliable population index of the eta Aquariids, we have to combine a relatively large number of shower meteors into a single data point. Figure 2 presents the r-profiles of the sporadic meteors and eta Aquariids, derived from data of the years 2011 till 2017 (again without 2013). Whereas the sporadic r-value scatters around 2.65, we find a clearly smaller population index near 2.0 for the eta Aquariids. We see an outlier at 46° solar longitude, but on average the population index is more than 0.5 smaller, i.e. the percentage of bright eta Aquariids is clearly higher than the percentage of bright sporadic meteors.

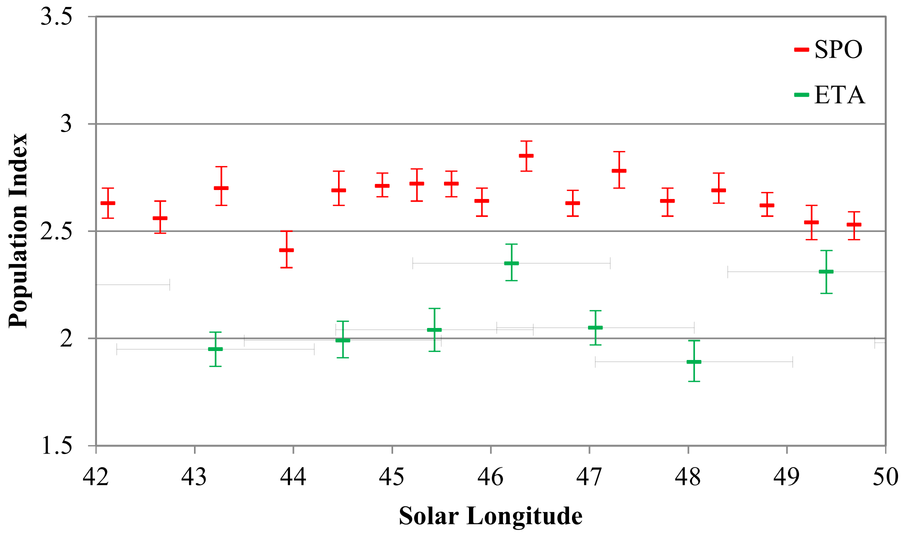

Figure 2: *Population index profile of the eta Aquariids (green) and sporadic meteors (red), derived from video observations between 2011 and 2017 (without 2013).*

The eta Lyrids follow directly after the peak of the eta Aquariids. Their activity is one order of magnitude lower, but they can be better observed from Europe. Figure 3 compares the flux density derived in 2017 with the higher resolution profile for 2011-2016. The new values fit perfectly to the previous profile.

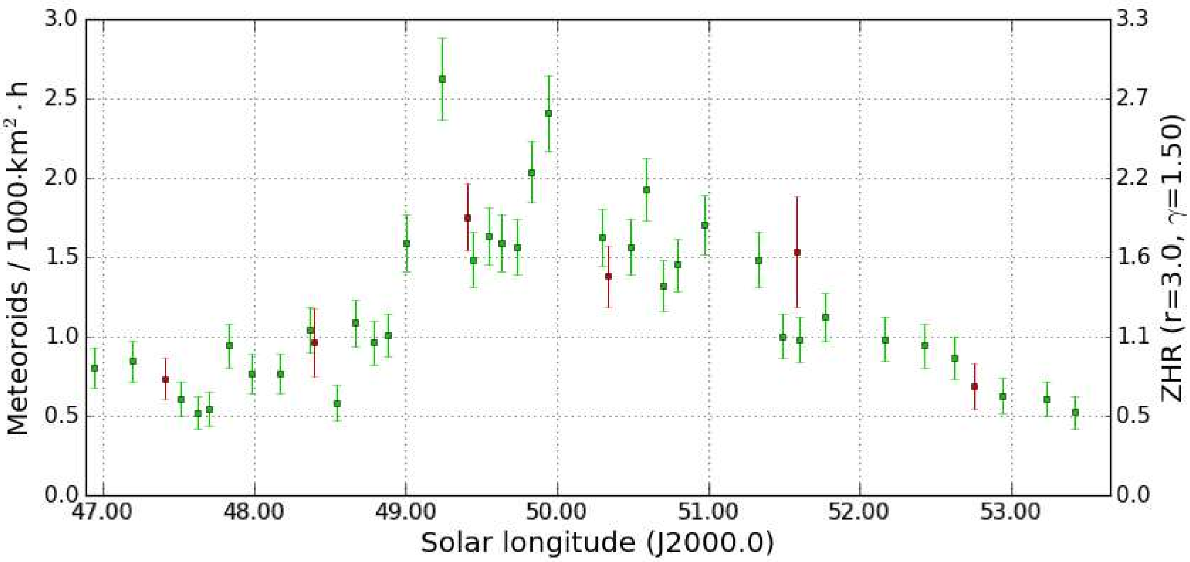

Figure 3: *Comparison of the eta Lyrid flux density 2017 (red) with the average flux density profile in the years 2011-2016 (green), derived from video data of the IMO Network.*

The population index of the eta Lyrids resembles to the eta Aquariids. Once more, the sporadic population index is about 2.6 and the r-value of the eta Lyrids somewhat below 2.0 An outlier at the begin of the activity interval (solar longitude of 48.5°) may be explained by increased "sporadic dilution" at the edges of the activity interval.

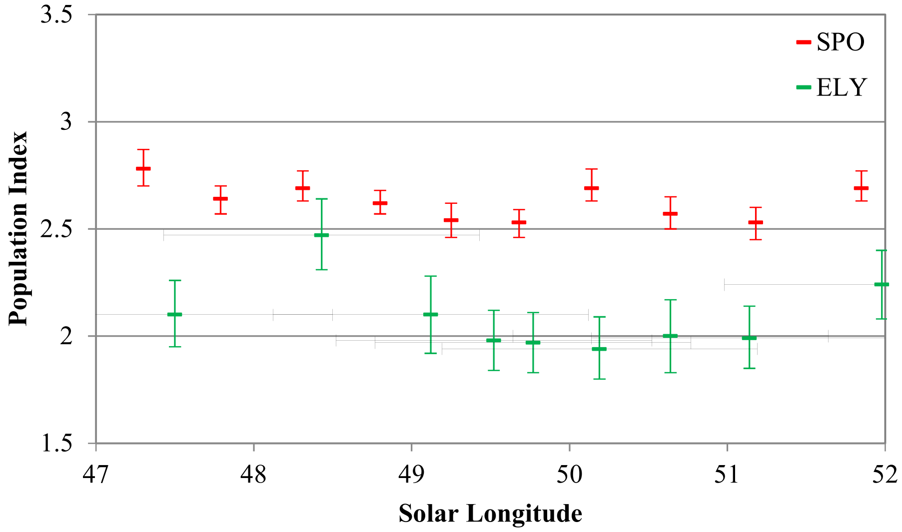

Figure 4: *Population index profile of the eta Lyrids (green) and sporadic meteors (red), derived from video observations between 2011 and 2017.*

In particular for the eta Aquariids it is vital to avoid inaccuracies or systematic errors in the flux density calculation, since under such extreme conditions they may quickly lead to significant deviations in the result. A discussion with Till Credner, an astronomy teacher from Baden Wurttemberg, revealed such an inaccuracy in the current flux density calculation procedure, that shall be discussed in more detail now.

To calculate the flux density, we divide the number of meteors by the effective observing time and collection area of the camera. The latter one is precisely calculated for each camera, whereby some parameters are determined on a pixel-by-pixel basis and others are constant in the full field of view.

Among the pixel-dependent parameters we have:

- the collection area per pixel, i.e. the monitored atmospheric layer
- the distance of the atmospheric layer (pixel) from the observer
- the distance of the pixel from the radiant and subsequently the expected angular velocity of shower meteors

Among the parameters which are constant in the whole field of view we have:

- the limiting magnitude (so far, we have no procedure to determine a variable limiting magnitude in the field of view, since often only a few stars are visible)
- the height of the meteor shower radiant above the horizon (incl. zenith attraction)
- the altitude of the meteor layer at which shower meteors typically light up (the altitude depends on the meteor shower velocity and the radiant altitude)
- the population index of the meteor shower

So which impact has the radiant height on the flux density? If the radiant is located at zenith, the meteoroids hit the atmosphere at right angle and the particle density peaks. The lower the radiant height, the shallower is the entry angle of the meteoroids in the atmosphere and the larger is the collection area they share. The number of meteoroids per unit atmosphere decreases approximately with the sine of the radiant height. However, in reality the entry angle is not constant, since meteoroids of a camera that looks towards the radiant (figure 5, right) hit the atmosphere at a slightly larger angle than meteoroids of a camera that looks into the opposite direction (figure 5, left). To model the effect correctly we need to determine the geographic coordinates of the location directly below the observed atmospheric layer, and determine the radiant height for this location. The deviation is bigger the lower the radiant (since the sine changes more rapidly for lower radiant heights) and the lower the field of view of the camera (since the observed atmospheric layer is farther away from the observer). In practice, IMO network cameras often observe atmospheric layers at a distance of a few hundred kilometers. Hence, the radiant altitude may deviate by a few degrees.

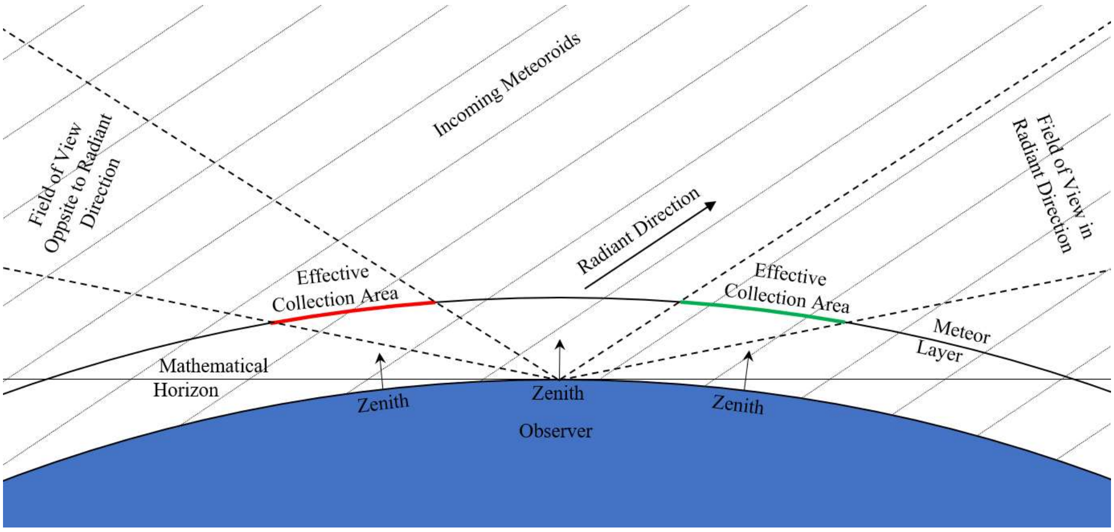

Figure 5: *Scale model to demonstrate the impact of the radiant altitude on the effective collection area. In case of a camera that observes in the radiant direction, the meteoroids hit the atmospheric layer (green segment, right) at a slightly larger angle than in case of a camera, that observes in the opposite direction (red segment, left). The difference depends on the radiant altitude at the location that lies directly below the observed atmospheric layer.*

To evaluate the effect, we calculated the geographic position below the atmospheric layer pixel-wise and determined the radiant altitude at that site. Thereafter we analysed how the effective collection area and flux density changed by this new algorithm over all cameras and meteor showers in May 2017. The deviation was typically less than 3% per night (figure 6), such that the described effect has no significant impact on the flux density. Still we will calculate the radiant altitude on a pixel-by-pixel basis in the future to eliminate all known inaccuracies.

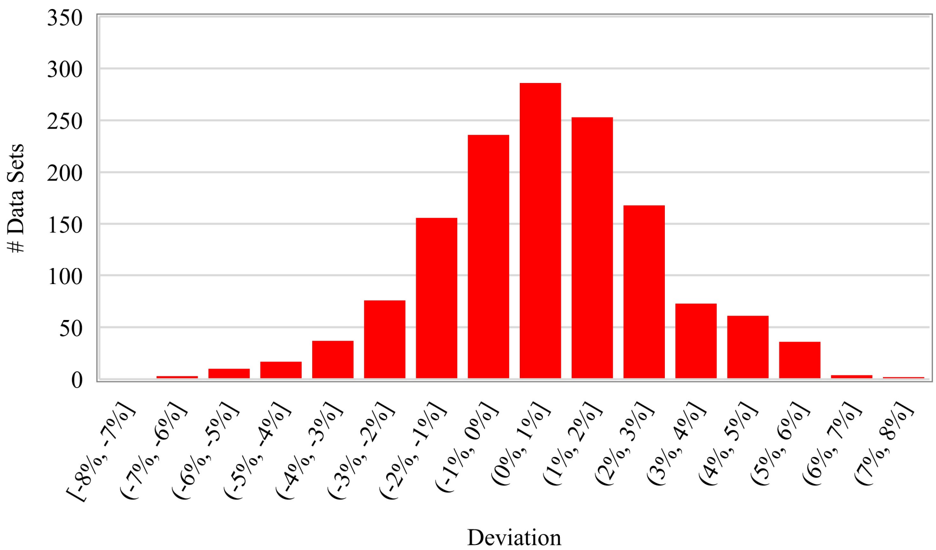

Figure 6: *Histogram over the deviations of the effective collection area between constant and pixel-wise computed radiant altitude.*

1. Observers

Code	Name	Place	Camera	FOV [°²]	Slim [mag]	Eff.CA [km²]	Nights	Time [h]	Meteors
ARLRA	Arlt	Ludwigsfelde/DE	LUDWIG2 (0.8/8)	1475	6.2	3779	23	86.2	324
BERER	Berkó	Ludanyhalaszi/HU	HULUD1 (0.8/3.8)	5542	4.8	3847	7	40.6	135
BOMMA	Bombardini	Faenza/IT	MARIO (1.2/4.0)	5794	3.3	739	28	144.7	438
BREMA	Breukers	Hengelo/NL	MBB3 (0.75/6)	2399	4.2	699	23	85.8	137
BRIBE	Klemt	Herne/DE	HERMINE (0.8/6)	2374	4.2	678	23	93.1	163
		Berg. Gladbach/DE	KLEMOI (0.8/6)	2286	4.6	1080	23	94.6	158
CARMA	Carli	Monte Baldo/IT	BMH2 (1.5/4.5)*	4243	3.0	371	22	96.0	383
CASFL	Castellani	Monte Baldo/IT	BMH1 (0.8/6)	2350	5.0	1611	20	114.3	191
CINFR	Cineglosso	Faenza/IT	JENNI (1.2/4)	5886	3.9	1222	28	158.0	237
CRIST	Crivello	Valbrevenna/IT	BILBO (0.8/3.8)	5458	4.2	1772	28	130.4	302
			C3P8 (0.8/3.8)	5455	4.2	1586	26	120.3	205
			STG38 (0.8/3.8)	5614	4.4	2007	29	146.3	537
ELTMA	Eltri	Venezia/IT	MET38 (0.8/3.8)	5631	4.3	2151	20	92.9	184
FORKE	Förster	Carlsfeld/DE	AKM3 (0.75/6)	2375	5.1	2154	21	104.7	227
GONRU	Goncalves	Foz do Arelho/PT	FARELHO1 (1.0/2.6)	6328	2.8	469	24	79.1	156
		Tomar/PT	TEMPLAR1 (0.8/6)	2179	5.3	1842	28	156.9	440
			TEMPLAR2 (0.8/6)	2080	5.0	1508	27	146.1	343
			TEMPLAR3 (0.8/8)	1438	4.3	571	21	122.7	113
			TEMPLAR4 (0.8/3.8)	4475	3.0	442	28	136.5	311
			TEMPLAR5 (0.75/6)	2312	5.0	2259	24	128.1	254
GOVMI	Govedic	Sredisce ob Dr./SI	ORION2 (0.8/8)	1447	5.5	1841	23	89.3	177
			ORION4 (0.95/5)	2662	4.3	1043	19	75.6	86
HERCA	Hergenrother	Tucson/US	SALSA3 (0.8/3.8)	2336	4.1	544	29	226.0	476
HINWO	Hinz	Schwarzenberg/DE	HINWO1 (0.75/6)	2291	5.1	1819	21	105.5	179
IGAAN	Igaz	Hodmezovasar./HU	HUHOD (0.8/3.8)	5502	3.4	764	15	63.4	45
		Budapest/HU	HUPOL (1.2/4)	3790	3.3	475	11	48.4	23
JONKA	Jonas	Budapest/HU	HUSOR (0.95/4)	2286	3.9	445	25	83.9	67
			HUSOR2 (0.95/3.5)	2465	3.9	715	23	100.6	108
KACJA	Kac	Kamnik/SI	CVETKA (0.8/3.8)	4914	4.3	1842	15	76.2	210
		Kostanjevec/SI	METKA (0.8/12)*	715	6.4	640	1	3.0	1
		Ljubljana/SI	ORION1 (0.8/8)	1399	3.8	268	24	108.7	353
		Kamnik/SI	REZIKA (0.8/6)	2270	4.4	840	15	79.8	380
			STEFKA (0.8/3.8)	5471	2.8	379	15	70.9	141
KOSDE	Koschny	Izana Obs./ES	ICC7 (0.85/25)*	714	5.9	1464	9	56.6	259
		La Palma / ES	ICC9 (0.85/25)*	683	6.7	2951	4	11.4	70
		Izana Obs./ES	LIC1(2.8/50)*	2255	6.2	5670	10	64.7	364
LOJTO	Łojek	Grabniak/PL	PAV57 (1.0/5)	1631	3.5	269	9	46.3	99
LOPAL	Lopes	Lisboa/PT	NASO1 (0.75/6)	2377	3.8	506	21	92.0	104
MACMA	Maciejewski	Chelm/PL	PAV35 (0.8/3.8)	5495	4.0	1584	23	80.1	104
			PAV36 (0.8/3.8)*	5668	4.0	1573	24	95.2	167
			PAV43 (0.75/4.5)*	3132	3.1	319	22	56.4	67
			PAV60 (0.75/4.5)	2250	3.1	281	27	101.6	223
MARRU	Marques	Lisbon/PT	CAB1 (0.75/6)	2362	4.8	1517	27	165.4	270
			RAN1 (1.4/4.5)	4405	4.0	1241	18	112.8	166
MASMI	Maslov	Novosimbirsk/RU	NOWATEC (0.8/3.8)	5574	3.6	773	22	51.6	98
MOLSI	Molau	Seysdorf/DE	AVIS2 (1.4/50)*	1230	6.9	6152	24	105.3	682
			ESCIMO2 (0.85/25)	155	8.1	3415	22	111.5	224
			MINCAM1 (0.8/8)	1477	4.9	1084	23	104.0	323
		Ketzür/DE	REMO1 (0.8/8)	1467	6.5	5491	26	81.6	271
			REMO2 (0.8/8)	1478	6.4	4778	25	78.2	319
			REMO3 (0.8/8)	1420	5.6	1967	27	106.2	313
			REMO4 (0.8/8)	1478	6.5	5358	26	98.9	414
MORJO	Morvai	Fülöpszallas/HU	HUFUL (1.4/5)	2522	3.5	532	25	135.3	96
MOSFA	Moschini	Rovereto/IT	ROVER (1.4/4.5)	3896	4.2	1292	22	16.6	106
OCHPA	Ochner	Albiano/IT	ALBIANO (1.2/4.5)	2944	3.5	358	15	86.8	106
OTTMI	Otte	Pearl City/US	ORIE1 (1.4/5.7)	3837	3.8	460	18	55.1	92
PERZS	Perkó	Becsehely/HU	HUBEC (0.8/3.8)*	5498	2.9	460	23	102.7	185
ROTEC	Rothenberg	Berlin/DE	ARMEFA (0.8/6)	2366	4.5	911	16	70.7	113
SARAN	Saraiva	Carnaxide/PT	RO1 (0.75/6)	2362	3.7	381	20	119.2	173
			RO2 (0.75/6)	2381	3.8	459	22	116.5	197
			RO3 (0.8/12)	710	5.2	619	24	125.3	272
			RO4 (1.0/8)	1582	4.2	549	20	108.5	96
			SOFIA (0.8/12)	738	5.3	907	19	97.6	120
SCHHA	Schremmer	Niederkrüchten/DE	DORAEMON (0.8/3.8)	4900	3.0	409	23	88.1	146
SLAST	Slavec	Ljubljana/SI	KAYAK1 (1.8/28)	563	6.2	1294	22	102.9	170
			KAYAK2 (0.8/12)	741	5.5	920	22	108.2	87
STOEN	Stomeo	Scorze/IT	MIN38 (0.8/3.8)	5566	4.8	3270	27	91.8	367
			NOA38 (0.8/3.8)	5609	4.2	1911	27	94.8	322
			SCO38 (0.8/3.8)	5598	4.8	3306	27	98.1	391
STRJO	Strunk	Herford/DE	MINCAM2 (0.8/6)	2354	5.4	2751	17	74.0	207
			MINCAM3 (0.8/6)	2338	5.5	3590	22	90.7	156
			MINCAM5 (0.8/6)	2349	5.0	1896	24	98.5	176
			MINCAM6 (0.8/6)	2395	5.1	2178	18	77.9	127
TEPIS	Tepliczky	Agostyan/HU	HUAGO (0.75/4.5)	2427	4.4	1036	30	120.9	142
			HUMOB (0.8/6)	2388	4.8	1607	28	125.0	190
WEGWA	Wegrzyk	Nieznaszyn/PL	PAV78 (0.8/6)	2286	4.0	778	21	57.2	73
YRJIL	Yrjölä	Kuusankoski/FI	FINEXCAM (0.8/6)	2337	5.5	3574	11	28.3	56
Sum							31	7319.1	16187

* active field of view smaller than video frame

2. Observing Times (h)

May	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15
ARLRA	-	3.0	-	-	-	2.2	2.2	2.6	-	3.5	4.2	-	3.5	3.3	4.9
BERER	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BOMMA	8.3	1.8	0.4	0.6	5.1	-	4.6	-	7.8	0.8	2.0	2.6	6.5	5.0	7.6
BREMA	-	-	-	-	2.5	1.9	-	6.4	5.4	6.3	0.4	0.8	3.9	5.8	-
BRIBE	-	-	-	-	6.2	6.3	-	4.4	6.3	6.4	-	1.9	1.4	1.2	-
	-	-	-	-	6.8	3.1	-	5.1	6.5	6.5	-	-	0.6	1.0	1.0
CARMA	-	-	3.7	1.9	7.4	-	3.9	0.2	-	-	-	-	2.0	-	2.2
CASFL	-	-	3.5	3.8	7.6	-	4.2	-	-	-	-	-	7.0	2.9	4.0
CRIST	8.3	5.4	-	0.7	6.0	-	5.3	0.4	7.7	0.9	1.9	2.6	7.2	5.4	7.6
	5.6	-	-	2.6	1.0	0.9	4.4	0.2	7.4	0.2	0.2	0.2	-	6.8	7.1
	7.8	2.6	0.5	2.2	0.7	2.5	7.1	2.2	6.7	0.4	-	-	-	7.1	6.1
DONJE	7.9	0.6	1.9	3.1	2.4	3.2	6.8	1.7	7.4	0.2	-	0.5	-	6.8	7.1
ELTMA	-	1.6	1.9	-	6.5	-	2.5	-	-	-	-	-	2.1	-	6.9
FORKE	-	6.2	-	-	-	6.9	-	-	6.1	6.6	1.2	4.8	4.5	2.1	6.3
GONRU	8.3	8.3	1.1	2.0	7.6	8.2	8.2	1.1	3.8	1.4	1.2	5.8	-	2.9	0.7
	8.4	8.4	5.8	-	7.9	8.1	8.1	7.8	2.9	0.8	2.8	3.8	3.8	5.6	2.9
	8.5	8.5	3.0	-	8.0	8.3	8.2	6.2	1.7	-	1.3	3.1	2.8	5.4	2.5
	8.5	8.4	-	-	7.3	8.1	8.1	7.1	-	0.6	-	2.3	1.5	4.9	-
	8.4	8.4	1.0	-	7.5	8.2	8.1	5.1	0.9	0.3	2.1	3.1	2.2	5.4	1.8
	8.1	8.3	3.1	-	7.7	8.0	7.9	4.8	-	0.4	0.9	2.1	-	4.6	2.1
GOVMI	1.3	5.0	6.2	3.8	4.2	-	2.3	-	-	0.8	1.5	-	1.9	-	6.2
	0.9	5.2	4.0	2.4	3.2	-	0.9	-	-	6.8	1.4	-	0.7	-	5.8
HERCA	9.3	9.3	8.7	9.2	9.2	7.1	9.0	2.3	2.8	3.0	-	9.0	8.6	8.4	8.9
HINWO	-	6.4	-	-	-	6.6	1.3	-	6.0	6.6	-	3.2	3.4	-	6.3
IGAAN	2.7	-	-	4.5	-	0.5	1.0	-	-	6.7	-	-	0.7	6.3	6.5
	-	-	-	-	4.1	-	5.9	3.7	-	5.7	1.3	-	-	5.2	-
JONKA	0.5	4.7	-	-	0.2	-	3.9	2.1	-	6.2	0.3	1.4	6.5	3.9	0.9
	1.9	5.2	-	0.8	-	-	4.2	-	-	6.2	0.4	-	6.9	6.8	3.8
KACJA	-	-	-	-	6.0	-	2.2	-	-	-	-	-	-	-	4.1
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	-	7.3	7.9	0.5	7.1	-	4.9	-	-	1.8	-	-	1.0	0.2	5.5
	-	-	-	-	7.6	-	2.9	-	-	-	-	-	-	-	4.2
	-	-	-	-	5.9	-	1.9	-	-	-	-	-	-	-	3.7
KOSDE	-	-	-	-	-	-	-	-	-	-	-	-	6.4	4.0	6.7
	-	-	-	-	-	6.0	-	4.0	0.1	1.3	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	2.1	8.5	5.6	5.2
LOJTO	-	-	-	-	-	-	-	-	-	-	-	5.7	6.4	-	2.7
LOPAL	7.7	7.9	0.3	0.3	3.3	6.2	7.7	5.9	-	-	-	3.2	0.3	4.3	0.6
MACMA	3.8	-	0.2	1.7	-	0.3	-	0.5	0.5	-	2.5	-	5.9	5.5	-
	3.4	0.8	-	2.3	-	0.5	-	0.7	3.4	2.2	5.3	-	6.1	5.7	0.6
	2.5	-	-	0.5	-	0.4	0.2	0.7	0.7	0.3	1.6	-	3.1	4.5	-
	3.8	0.7	2.6	2.4	-	2.6	0.3	0.7	4.0	3.1	6.1	-	6.3	5.6	0.7
MARRU	8.5	8.5	4.8	-	8.3	8.2	8.2	6.8	1.3	-	3.8	4.0	7.5	7.6	3.5
	8.5	2.2	-	-	7.2	8.4	7.9	5.4	1.0	-	-	2.2	-	-	-
MASMI	-	5.6	2.8	5.1	1.3	-	-	-	-	1.6	1.3	1.3	1.8	2.8	0.9
MOLSI	-	1.9	3.5	-	6.5	-	-	-	3.9	6.1	-	2.9	4.6	1.7	5.8
	-	-	3.9	-	7.0	-	-	-	3.6	6.7	-	2.4	5.2	1.6	6.4
	-	-	3.9	-	7.0	-	-	-	3.6	6.7	0.2	0.3	3.8	0.5	6.4
	-	1.2	-	-	-	2.3	4.0	1.2	0.6	5.0	2.4	2.8	3.0	2.3	4.4
	-	0.4	1.0	-	-	0.3	1.0	-	-	2.0	0.9	1.5	3.0	2.1	4.2
	-	1.2	2.3	-	-	2.4	3.9	1.5	1.0	6.1	2.2	4.0	3.6	2.9	5.4
	-	-	1.4	-	-	1.5	1.7	1.0	0.5	6.0	1.5	3.7	3.8	2.6	5.2
MORJO	5.2	-	0.2	4.2	-	-	6.1	4.8	4.3	7.1	-	4.6	6.9	7.0	-
MOSFA	-	-	-	-	-	-	0.4	0.2	0.3	0.3	-	-	1.5	0.2	0.3
OCHPA	-	-	-	2.8	7.8	-	5.3	-	-	-	-	-	4.1	-	5.9
OTTMI	1.4	1.0	1.3	0.5	1.4	1.0	-	1.0	0.2	0.2	0.5	6.0	7.3	4.1	-
PERZS	4.3	5.7	4.0	2.2	2.1	-	-	-	-	4.6	0.2	-	5.9	0.3	6.0
ROTEC	-	-	-	-	-	-	-	-	-	-	-	-	4.0	4.2	5.2
SARAN	8.9	8.8	2.2	0.8	4.9	6.0	6.5	-	-	-	-	3.8	-	7.2	-
	8.3	8.7	1.6	0.4	6.8	8.3	8.3	7.7	0.2	-	-	4.1	-	-	-
	7.9	8.1	1.8	-	6.6	8.0	7.9	7.3	0.4	0.8	-	3.9	0.6	1.5	1.6
	8.1	8.5	-	-	5.0	8.0	8.0	5.6	0.2	-	-	3.0	-	4.3	-
	5.3	8.6	0.3	0.8	6.2	7.2	6.8	-	0.5	-	-	2.8	-	5.0	1.1
SCHHA	3.1	-	-	-	6.5	3.4	-	4.4	6.6	6.5	-	0.3	4.3	2.0	-
SLAST	-	7.1	7.2	1.6	6.6	-	3.6	-	-	-	-	-	0.7	0.8	4.7
	-	7.5	7.7	1.2	7.6	-	5.0	-	-	-	-	0.8	-	0.8	-
STOEN	0.5	1.8	1.7	0.2	5.7	0.2	2.9	0.2	-	0.2	-	3.8	1.0	-	7.2
	0.2	1.8	1.3	0.4	5.5	0.6	1.8	0.2	-	0.3	-	4.7	-	-	7.1
	0.5	1.7	1.1	0.2	6.2	0.3	4.3	-	0.2	1.2	-	4.9	2.0	-	7.3
STRJO	-	-	-	-	-	-	-	-	3.4	6.3	-	3.4	0.7	2.3	-
	-	-	-	-	1.9	6.2	2.2	3.5	5.5	6.2	-	4.3	1.4	3.4	-
	-	0.5	1.0	-	2.7	6.3	-	5.4	5.1	6.1	-	3.9	1.4	2.8	-
	-	-	-	-	-	6.1	1.3	5.8	5.1	6.2	-	3.5	-	-	-
TEPIS	4.0	7.3	1.0	2.9	0.2	0.2	6.0	3.1	5.5	6.8	1.5	0.2	6.7	3.3	4.8
	1.4	7.4	1.1	3.4	2.3	-	5.9	3.0	5.4	6.8	2.8	-	6.4	5.4	5.6
WEGWA	-	0.5	-	3.3	0.5	1.7	-	-	4.0	2.5	4.9	-	3.3	-	3.6
YRJIL	4.1	3.7	3.1	3.4	3.2	1.9	1.9	-	2.4	1.6	1.7	-	1.3	-	-
Sum	206.1	233.7	116.0	78.7	276.0	194.6	249.1	144.0	152.9	189.9	62.5	141.3	217.5	220.9	245.8

May	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
ARLRA	-	4.9	4.9	-	4.5	4.6	4.6	2.7	4.4	3.8	4.3	4.3	3.7	4.2	1.8	4.1
BERER	-	6.6	5.8	6.4	-	-	-	-	6.0	-	3.9	5.8	6.1	-	-	-
BOMMA	7.5	7.4	4.5	4.2	-	7.1	6.6	6.4	0.5	6.2	6.8	7.0	7.0	6.9	6.8	6.7
BREMA	-	5.7	-	0.6	5.5	5.5	1.6	4.7	3.2	5.2	5.2	4.9	0.7	1.7	3.0	4.9
BRIBE	-	5.8	3.3	2.1	5.4	4.8	1.6	2.0	5.5	5.4	5.4	3.9	3.4	1.8	3.5	5.1
	-	5.6	3.3	3.5	5.8	5.8	1.9	4.2	5.5	5.5	5.4	3.6	3.9	4.0	1.2	4.8
CARMA	2.9	-	2.2	5.4	2.6	6.8	6.8	6.0	5.5	3.7	6.5	2.2	6.6	5.8	5.6	6.1
CASFL	7.3	-	-	6.3	3.1	7.1	7.1	6.4	5.8	4.3	6.8	-	6.8	6.8	6.8	6.7
CRIST	7.5	7.4	5.6	4.8	-	7.3	7.3	6.7	2.7	7.0	7.0	7.1	7.0	7.1	7.1	7.0
	7.0	7.0	0.2	5.2	6.9	6.8	6.8	6.2	6.1	5.9	6.6	6.6	6.6	6.5	6.5	2.9
	6.1	7.0	0.2	1.4	6.9	6.9	6.4	6.4	-	1.6	6.7	6.6	6.6	5.6	6.0	-
DONJE	7.0	7.0	0.7	5.5	6.9	6.8	6.8	6.8	6.6	5.4	6.6	6.6	6.6	6.5	6.5	4.4
ELTMA	5.8	1.4	5.3	5.5	-	7.0	5.9	3.3	-	4.8	6.1	6.0	6.6	5.8	2.4	5.5
FORKE	-	6.1	6.0	-	1.6	5.7	5.9	-	3.9	-	5.4	5.5	5.5	5.4	3.7	5.3
GONRU	-	3.5	5.2	6.4	-	-	0.4	1.0	0.3	-	0.2	-	0.2	0.7	0.6	-
	-	7.8	7.8	7.7	3.6	1.4	7.7	7.6	1.4	3.9	7.4	-	2.6	7.3	6.2	7.4
	-	7.9	7.9	7.8	3.1	1.5	7.7	7.7	2.0	3.3	7.6	-	1.6	6.7	6.3	7.5
	-	7.3	7.7	7.7	1.3	3.2	7.5	7.4	-	-	6.4	-	-	5.6	4.6	7.2
	-	7.6	7.9	7.8	1.5	1.3	7.8	7.7	1.8	2.8	6.5	-	1.1	6.7	6.1	7.4
	-	7.8	7.6	7.5	-	3.3	7.5	7.6	-	1.6	7.2	-	1.3	6.9	4.6	7.2
GOVMI	0.6	6.7	2.6	6.6	-	6.4	0.4	2.3	-	3.8	2.2	6.2	6.2	6.1	6.0	-
	-	-	6.4	6.3	-	6.2	-	1.2	-	3.3	-	6.0	4.3	5.2	5.4	-
HERCA	8.6	8.9	8.9	8.7	8.8	-	8.7	8.7	8.6	7.5	7.9	8.6	8.6	8.3	7.2	3.2
HINWO	-	6.1	6.1	-	2.4	5.8	5.9	-	4.9	3.8	5.7	5.6	5.6	5.5	3.5	4.8
IGAAN	2.2	6.5	6.5	6.4	2.5	-	-	-	-	-	-	-	-	-	4.6	5.8
	5.5	5.9	-	4.5	-	4.8	1.8	-	-	-	-	-	-	-	-	-
JONKA	2.4	6.6	6.6	5.2	0.6	3.5	0.3	-	5.6	1.1	4.7	3.2	6.1	5.7	-	1.7
	5.5	6.7	6.7	6.0	0.9	5.5	0.2	-	6.1	0.8	5.0	3.0	6.3	6.2	5.5	-
KACJA	2.3	6.1	6.8	6.7	-	6.6	-	-	-	3.5	2.3	6.0	6.3	6.3	6.1	4.9
	-	-	-	-	-	-	-	-	-	-	3.0	-	-	-	-	-
	0.5	6.4	7.1	6.6	-	6.0	2.7	0.7	1.1	6.0	6.5	5.5	6.7	3.5	6.6	6.6
	1.6	6.3	6.9	6.9	-	6.8	-	-	-	3.5	2.4	6.4	6.5	6.5	6.3	5.0
	2.2	5.9	6.8	6.8	-	6.6	-	-	0.2	1.5	-	6.2	6.4	6.4	6.0	4.4
KOSDE	-	-	-	-	-	-	-	-	7.6	8.1	7.0	2.0	8.0	6.8	-	-
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	8.5	8.0	8.4	2.9	8.2	7.3	-	-
LOJTO	-	5.6	-	6.0	5.5	2.8	-	-	-	-	-	-	5.8	-	-	5.8
LOPAL	0.3	-	7.7	7.7	0.5	-	7.4	-	-	3.2	2.8	-	-	-	7.5	7.2
MACMA	5.7	5.8	5.8	5.7	5.7	1.7	1.0	-	-	5.3	1.7	5.4	5.1	1.1	4.2	5.0
	6.0	6.1	6.1	6.1	5.2	-	3.5	-	-	5.7	2.8	5.6	5.5	1.1	5.1	5.4
	4.4	3.3	-	5.5	2.1	1.8	-	-	-	5.7	2.7	5.7	5.4	1.4	2.3	1.6
	5.9	6.0	6.0	5.8	4.4	1.3	3.7	-	-	5.5	2.3	5.4	5.3	1.1	4.7	5.3
MARRU	1.9	7.9	7.8	7.8	-	2.4	7.6	7.7	2.8	7.6	5.7	-	2.9	7.5	7.4	7.4
	-	6.7	7.9	7.9	-	-	7.9	7.8	-	5.4	6.0	-	-	5.3	7.6	7.5
MASMI	0.4	4.1	4.0	1.4	-	3.7	3.0	1.7	-	-	-	3.1	0.3	3.0	1.6	0.8
MOLSI	5.7	5.7	5.6	3.1	5.4	5.5	5.4	1.2	3.5	5.2	5.2	5.1	5.1	-	1.8	4.9
	6.3	6.3	6.2	3.5	5.9	6.1	6.0	-	3.3	5.9	5.8	5.8	5.7	-	2.4	5.5
	6.3	6.1	6.2	3.3	4.4	6.0	6.0	-	3.3	5.9	5.8	5.8	5.7	-	1.7	5.1
	0.3	4.7	4.6	1.9	2.9	4.5	4.4	2.6	4.2	-	4.1	4.1	3.9	3.8	2.5	3.9
	-	5.2	4.8	2.2	3.8	4.9	4.9	2.9	4.7	4.7	4.6	4.6	4.0	4.2	1.9	4.4
	-	5.7	5.4	2.3	5.0	5.4	5.3	3.4	5.2	5.2	5.1	5.1	4.3	4.4	3.1	4.8
	-	5.7	5.3	2.2	5.3	5.4	5.3	3.5	5.2	5.1	5.1	5.1	4.5	4.6	2.9	4.8
MORJO	3.9	6.9	6.8	6.7	2.0	6.6	6.4	-	6.6	4.3	5.4	6.4	6.3	6.4	6.2	4.0
MOSFA	1.7	-	0.5	0.8	0.5	2.1	1.5	0.3	1.1	0.3	1.1	0.2	1.2	0.5	0.8	0.8
OCHPA	6.8	-	-	-	-	6.7	-	5.4	6.6	5.4	5.7	5.3	5.9	6.4	-	6.7
OTTMI	-	-	-	-	-	-	-	-	-	-	-	1.5	7.2	6.3	7.1	7.1
PERZS	2.7	7.0	6.9	6.9	3.5	6.7	3.7	3.2	-	3.5	3.9	6.5	6.5	-	6.4	-
ROTEC	-	5.4	5.3	-	5.1	4.1	5.1	1.7	4.2	4.8	4.9	4.8	3.6	3.7	-	4.6
SARAN	-	8.1	8.3	8.4	1.3	-	8.1	-	5.9	3.1	5.5	-	-	6.1	8.0	7.3
	-	8.1	8.1	-	1.3	-	8.0	7.7	-	3.1	5.0	0.2	0.2	4.7	7.9	7.8
	-	7.8	7.8	-	0.7	-	7.8	7.7	5.4	4.1	6.5	-	-	5.9	7.7	7.5
	-	7.2	7.5	-	0.2	-	7.6	6.9	4.8	3.0	2.9	-	-	2.4	7.6	7.7
	-	8.0	8.0	7.9	-	-	7.9	-	4.5	-	3.4	-	-	5.6	7.7	-
SCHHA	-	3.9	2.1	0.9	5.7	5.8	-	3.0	3.0	5.6	5.5	2.8	0.9	3.5	3.2	5.1
SLAST	-	5.8	6.3	6.2	-	5.1	3.5	1.3	1.9	5.9	5.9	5.9	5.8	5.7	5.5	5.8
	2.3	6.2	6.8	6.5	-	5.5	3.0	2.5	0.6	6.5	5.5	6.4	6.5	6.5	6.3	6.5
STOEN	6.5	-	5.1	4.8	2.9	7.0	4.2	3.0	2.3	3.4	3.4	3.7	6.3	5.5	5.0	3.3
	6.4	0.2	5.8	4.7	2.7	7.0	4.3	4.3	2.5	3.9	4.1	4.1	6.8	5.3	5.2	3.6
	6.4	-	5.0	5.0	2.9	7.0	3.8	2.8	2.7	3.4	4.0	3.5	6.8	5.4	4.7	4.8
STRJO	-	5.8	-	-	5.6	5.4	-	4.1	4.8	5.0	5.2	5.0	3.4	5.0	3.8	4.8
	-	5.6	4.4	-	5.5	5.2	-	1.9	3.0	5.0	5.1	4.7	2.7	4.8	3.4	4.8
	-	5.8	5.6	-	5.6	5.3	0.5	3.9	4.5	5.1	5.1	5.0	3.4	5.0	3.7	4.8
	-	5.2	-	-	5.4	5.1	0.5	-	3.2	5.0	5.0	4.6	3.4	4.0	3.7	4.8
TEPIS	5.7	6.5	6.4	5.3	-	6.2	3.2	1.6	2.8	4.8	6.0	4.2	5.9	4.2	3.6	1.0
	6.4	6.1	6.4	5.7	-	6.3	1.8	1.6	4.5	4.8	6.0	4.8	5.9	4.9	2.2	0.7
WEGWA	4.0	0.5	5.8	0.8	-	-	2.9	1.9	-	-	1.4	4.7	4.5	1.8	0.2	4.4
YRJIL	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sum	178.5	380.9	359.8	309.5	180.9	299.7	283.1	209.3	210.9	281.7	339.3	276.8	319.8	322.9	313.1	323.9

3. Results (Meteors)

May	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15
ARLRA	-	11	-	-	-	3	3	6	-	4	18	-	17	5	10
BERER	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BOMMA	27	6	1	7	10	-	23	-	34	6	4	7	20	10	23
BREMA	-	-	-	-	1	4	-	6	11	11	2	1	10	7	-
BRIBE	-	-	-	-	8	9	-	8	15	14	-	6	3	2	-
	-	-	-	-	22	2	-	4	13	9	-	-	2	2	1
CARMA	-	-	6	17	32	-	12	1	-	-	-	-	19	-	16
CASFL	-	-	5	10	17	-	6	-	-	-	-	-	14	1	6
CRIST	13	1	-	3	10	-	10	1	9	1	3	8	9	5	18
	7	-	-	3	2	3	22	1	20	1	1	1	-	16	17
	13	8	3	8	2	6	21	3	9	3	-	-	-	7	15
DONJE	33	3	8	20	3	19	32	5	29	1	-	2	-	27	31
ELTMA	-	4	8	-	24	-	9	-	-	-	-	-	4	-	13
FORKE	-	17	-	-	-	23	-	-	18	19	5	14	5	6	10
GONRU	5	14	6	19	15	14	15	2	8	2	3	8	-	8	3
	38	31	8	-	22	24	29	18	10	1	3	9	6	16	1
	22	26	7	-	27	29	27	10	6	-	3	4	4	5	1
	10	16	-	-	6	8	8	5	-	1	-	6	1	1	-
	15	27	5	-	30	24	21	10	4	2	3	10	7	9	1
	9	26	3	-	27	21	20	10	-	1	2	5	-	2	4
GOVMI	2	8	3	5	6	-	2	-	-	4	4	-	4	-	15
	1	4	1	2	8	-	1	-	-	10	1	-	2	-	8
HERCA	25	19	24	26	23	19	21	14	3	12	-	28	12	21	18
HINWO	-	14	-	-	-	8	2	-	7	17	-	4	5	-	15
IGAAN	3	-	-	2	-	1	4	-	-	5	-	-	2	2	6
	-	-	-	-	2	-	4	1	-	3	1	-	-	1	-
JONKA	1	2	-	-	1	-	8	1	-	3	2	4	3	2	1
	1	2	-	3	-	-	10	-	-	3	2	-	12	5	3
KACJA	-	-	-	-	13	-	3	-	-	-	-	-	-	-	21
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	-	25	22	1	30	-	7	-	-	3	-	-	2	1	9
	-	-	-	-	45	-	9	-	-	-	-	-	-	-	25
	-	-	-	-	8	-	6	-	-	-	-	-	-	-	8
KOSDE	-	-	-	-	-	-	-	-	-	-	-	-	31	11	20
	-	-	-	-	-	30	-	38	1	1	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	10	33	29	23
LOJTO	-	-	-	-	-	-	-	-	-	-	-	13	12	-	2
LOPAL	10	5	2	3	7	9	14	4	-	-	-	1	2	2	3
MACMA	6	-	1	4	-	2	-	2	3	-	6	-	7	7	-
	3	2	-	9	-	1	-	2	4	2	9	-	8	7	2
	4	-	-	1	-	2	1	4	2	1	4	-	6	3	-
	5	3	1	7	-	4	1	6	6	2	11	-	13	19	1
MARRU	9	25	3	-	21	20	7	16	3	-	5	5	14	7	3
	20	14	-	-	10	12	14	16	1	-	-	4	-	-	-
MASMI	-	9	7	9	6	-	-	-	-	2	4	3	3	1	2
MOLSI	-	2	11	-	37	-	-	-	12	29	-	10	20	3	42
	-	-	6	-	16	-	-	-	8	14	-	2	8	1	9
	-	-	4	-	28	-	-	-	14	16	1	2	9	2	11
	-	2	-	-	-	1	9	3	1	12	3	7	10	6	10
	-	1	2	-	-	3	3	-	-	6	3	2	5	6	14
	-	1	1	-	-	4	13	7	2	14	2	7	13	9	13
	-	-	1	-	-	3	6	7	1	8	6	9	14	9	18
MORJO	2	-	1	2	-	-	7	4	3	5	-	6	2	4	-
MOSFA	-	-	-	-	-	-	2	1	2	2	-	-	9	1	2
OCHPA	-	-	-	9	11	-	8	-	-	-	-	-	4	-	6
OTTMI	9	6	10	4	10	7	-	7	1	1	3	5	3	2	-
PERZS	1	2	5	2	6	-	-	-	-	8	1	-	11	1	14
ROTEC	-	-	-	-	-	-	-	-	-	-	-	-	4	2	2
SARAN	16	12	2	1	16	10	10	-	-	-	-	1	-	5	-
	13	24	1	1	6	23	20	6	1	-	-	3	-	-	-
	16	22	3	-	18	27	29	17	1	2	-	7	2	1	2
	5	15	-	-	4	4	7	7	1	-	-	2	-	1	-
	14	17	1	5	8	9	10	-	2	-	-	2	-	2	1
SCHHA	4	-	-	-	16	4	-	8	15	16	-	1	5	2	-
SLAST	-	24	3	1	9	-	3	-	-	-	-	-	3	1	5
	-	6	4	3	7	-	5	-	-	-	-	1	-	1	-
STOEN	2	9	10	1	30	1	21	1	-	1	-	16	5	-	26
	2	10	11	3	23	2	21	1	-	1	-	14	-	-	30
	1	4	3	1	41	2	29	-	1	3	-	22	9	-	27
STRJO	-	-	-	-	-	-	-	-	13	8	-	6	2	3	-
	-	-	-	-	2	5	1	5	11	10	-	4	3	4	-
	-	1	2	-	5	5	-	13	6	11	-	2	4	5	-
	-	-	-	-	-	6	1	7	7	12	-	5	-	-	-
TEPIS	2	11	3	3	1	1	7	2	7	6	3	1	5	3	6
	1	14	2	7	3	-	8	3	6	11	6	-	8	9	7
WEGWA	-	1	-	3	1	1	-	-	4	3	7	-	2	-	4
YRJIL	8	7	2	14	5	4	2	-	4	3	5	-	2	-	-
Sum	378	513	212	219	741	419	594	293	339	346	136	290	454	330	604

May	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
ARLRA	-	20	22	-	15	20	24	11	13	21	22	22	11	14	8	24
BERER	-	25	14	17	-	-	-	-	22	-	19	17	21	-	-	-
BOMMA	20	16	12	17	-	18	17	16	2	21	22	23	21	22	20	13
BREMA	-	11	-	2	6	9	1	7	8	8	7	3	2	1	4	15
BRIBE	-	6	4	3	10	7	2	1	13	13	5	7	4	2	11	10
	-	5	3	7	10	11	2	5	12	11	7	8	7	4	3	8
CARMA	22	-	3	22	10	29	25	16	26	14	31	4	27	21	19	11
CASFL	15	-	-	7	3	18	11	11	10	3	15	-	11	7	14	7
CRIST	7	11	8	5	-	12	7	8	1	15	11	9	14	14	12	12
	24	22	1	11	13	18	13	12	7	10	12	16	16	17	15	1
	10	11	1	1	2	5	8	6	-	2	5	11	10	16	19	-
DONJE	32	23	3	15	19	29	27	19	7	16	21	23	22	33	31	4
ELTMA	7	2	6	11	-	15	6	5	-	9	10	11	17	13	6	4
FORKE	-	10	18	-	1	10	10	-	3	-	15	12	11	9	4	7
GONRU	-	5	10	4	-	-	2	2	2	-	1	-	1	4	3	-
	-	29	28	24	3	2	27	18	1	6	14	-	8	18	24	22
	-	29	22	21	6	3	14	17	1	2	17	-	4	10	12	14
	-	2	7	7	1	2	8	5	-	-	2	-	-	8	5	4
	-	14	19	16	3	1	19	18	1	3	12	-	2	9	13	13
	-	26	18	19	-	2	8	10	-	1	5	-	3	17	9	6
GOVMI	2	8	8	13	-	16	2	7	-	15	4	13	12	10	14	-
	-	-	9	5	-	4	-	1	-	7	-	7	5	4	6	-
HERCA	15	13	11	26	22	-	14	17	10	8	12	12	16	17	17	1
HINWO	-	7	8	-	7	13	7	-	6	5	12	12	6	7	6	11
IGAAN	2	4	3	4	2	-	-	-	-	-	-	-	-	-	3	2
	3	3	-	1	-	3	1	-	-	-	-	-	-	-	-	-
JONKA	6	3	3	4	1	4	1	-	3	2	3	2	3	2	-	2
	9	9	6	7	1	4	1	-	3	1	6	3	10	5	2	-
KACJA	3	25	29	18	-	15	-	-	-	5	5	8	17	14	24	10
	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-
	1	25	28	22	-	23	5	2	6	27	20	21	26	14	14	19
	2	35	43	46	-	38	-	-	-	8	7	20	26	22	28	26
	3	14	13	15	-	8	-	-	1	1	-	9	16	13	14	12
KOSDE	-	-	-	-	-	-	-	-	43	38	30	4	48	34	-	-
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	40	55	56	17	54	47	-	-
LOJTO	-	14	-	14	11	7	-	-	-	-	-	-	8	-	-	18
LOPAL	1	-	11	5	2	-	7	-	-	2	1	-	-	-	8	5
MACMA	8	6	2	4	3	2	3	-	-	5	3	6	8	3	6	7
	8	8	11	11	4	-	6	-	-	9	8	8	14	2	10	19
	3	2	-	6	1	1	-	-	-	1	4	7	2	3	1	8
	12	13	22	13	6	5	6	-	-	14	5	16	12	1	8	11
MARRU	3	15	15	15	-	4	7	6	1	11	2	-	8	18	19	8
	-	7	11	14	-	-	6	3	-	3	4	-	-	3	13	11
MASMI	1	5	11	1	-	4	6	5	-	-	-	5	1	7	5	1
MOLSI	44	51	35	27	29	46	44	5	19	41	45	57	43	-	12	18
	25	9	13	7	8	8	17	-	4	9	19	18	14	-	1	8
	24	18	18	19	15	11	16	-	8	18	32	20	17	-	2	18
	1	27	14	7	5	17	16	11	12	-	17	24	5	21	6	24
	-	32	12	4	11	19	32	12	15	30	27	30	8	11	5	26
	-	16	10	4	14	14	20	15	24	25	18	20	7	13	6	21
	-	27	19	6	22	23	28	16	28	26	32	35	11	24	7	28
MORJO	7	9	4	2	2	9	2	-	4	3	4	3	4	3	3	1
MOSFA	10	-	3	5	3	12	10	2	8	2	7	1	8	3	7	6
OCHPA	11	-	-	-	-	7	-	1	8	10	7	2	4	8	-	10
OTTMI	-	-	-	-	-	-	-	-	-	-	-	2	6	4	8	4
PERZS	2	19	9	24	2	15	3	6	-	4	10	7	19	-	14	-
ROTEC	-	12	14	-	6	9	9	1	4	7	14	16	2	3	-	8
SARAN	-	12	23	12	2	-	12	-	3	4	6	-	-	5	12	9
	-	12	15	-	2	-	12	10	-	2	6	1	1	6	19	13
	-	16	17	-	3	-	9	12	6	6	5	-	-	7	33	11
	-	3	4	-	1	-	6	6	2	6	1	-	-	4	10	7
	-	8	12	10	-	-	5	-	1	-	2	-	-	2	9	-
SCHHA	-	1	5	1	10	11	-	1	6	8	12	3	2	4	5	6
SLAST	-	14	16	6	-	9	8	1	2	12	10	8	6	6	14	9
	1	5	4	6	-	2	4	2	2	10	5	4	5	2	3	5
STOEN	26	-	10	21	24	32	12	7	8	15	16	14	22	24	10	3
	26	1	16	17	13	28	15	9	8	9	9	11	12	13	11	6
	28	-	7	26	20	29	15	7	13	15	11	11	24	16	14	12
STRJO	-	10	-	-	16	14	-	6	10	28	18	17	7	8	15	26
	-	6	2	-	15	6	-	3	6	15	10	13	6	4	12	13
	-	10	3	-	9	4	1	2	2	9	16	12	13	9	9	23
	-	9	-	-	13	3	1	-	1	8	8	8	7	3	10	18
TEPIS	7	6	6	9	-	9	4	3	3	6	10	2	5	3	6	2
	9	11	8	6	-	17	5	4	9	8	9	5	3	1	6	4
WEGWA	4	2	5	2	-	-	3	2	-	-	8	8	6	3	1	3
YRJIL	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sum	444	829	747	674	407	716	612	372	458	708	830	688	771	675	700	688